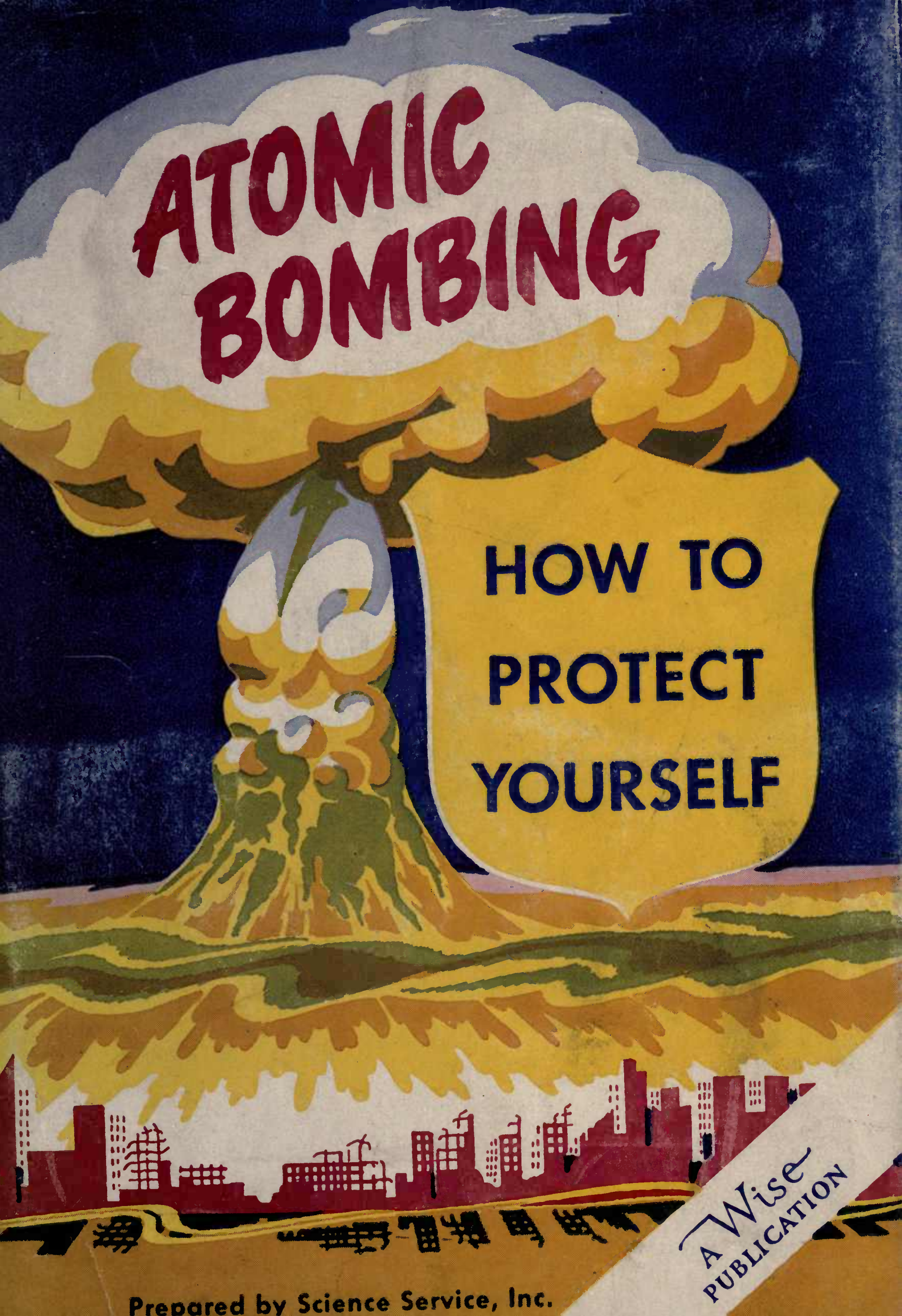
ATOMIC BOMBING
HOW TO PROTECT YOURSELF
A Wise PUBLICATION
Prepared by Science Service, Inc.

1.95

This Momentous Volume Aims to Save Lives; Perhaps Your Own or Your Entire Family!

ATOMIC BOMBING — HOW TO PROTECT YOURSELF

WRITTEN BY SCIENCE SERVICE, Inc.

192 "What-to-do" Pages 109 Pictures

BY the grace of Providence, we Americans may never be subjected to a sneak attack of atom bombs dropped without warning on key points all over the nation. But what priceless comfort to possess all this wonderful guidance in case the worst *should* happen. Just think of the precious lives it may help you save!

Here, right at your fingertips, are *scores* of scientifically accurate precautions and Government recommended procedures. Step-by-step picturized instructions on how to protect yourself and your loved ones — how to administer life-saving first aid — what to do *before, during* and *after* an attack!

Here's a Mere Glimpse of the Hundreds of Vital Questions this Volume Answers . . .

- If you are within 1,000 yards of the blast, what should you do immediately to minimize your danger?
- What types of clothing help protect your body against slow-killing ionizing rays?
- Where are the safest places to hide at home and away?
- How can you protect yourself from "prompt" and "lingering" radioactivity?
- How to protect yourself from burns and blindness.
- How can you decontaminate your family, pets, food and home of radioactivity?
- Plus hundreds of other life-saving safety measures and "what-to-do" information!

This book incorporates protective measures which were tried at Bikini and Eniwetok where more than 40,000 took part in atomic bomb tests.

This priceless book is urgent "must" reading for *every* man, woman and child! This may be the chance of your lifetime to SAVE your life and those of your loved ones!

Look for the *WISE* old bird! *WISE* books are trademarked

WM. H. WISE & CO., INC., NEW YORK

ATOMIC BOMBING
HOW TO PROTECT YOURSELF

by

SCIENCE SERVICE

Watson Davis
Jane Stafford
Marjorie Van de Water
Sam Matthews
Wadsworth Likely

New York
Wm. H. Wise & Co., Inc.
1950

10501

PRINTED IN THE UNITED STATES OF AMERICA

FOREWORD

In American democracy one of the fundamental principles is that the people shall know what is happening and what is likely to happen. Freedom of information—the right to know—is implicit in the American system. It is for that reason that our government and the public officials and scientists involved, are backed by public opinion when it reveals all that it can about atomic energy that can be told without giving aid and comfort to a potential enemy.

This right and duty to publish what the people wish to know and should know motivates this book, as it does the whole civilian defense program of our nation confronted by atomic danger from without.

The facts within this book and the conclusions reached, not always pleasant and reassuring, will serve to alert and safeguard not alone the ordinary citizen, but many members of the great body of public officials, ranging from those in villages to the Federal Government itself.

The information conveyed in this book is of necessity a part of the American scene today. Those of us who have to confront the dangers of atomic attack should rejoice that we at least, unlike those behind the Iron Curtain, have some immunizing appreciation of these dangers. When danger is known, something can be done about it. Ignorance is a breeder of false security. We are convinced here in America that the right to know is as precious as our strength to resist the forces in the world which would like to enslave us in ignorance.

WATSON DAVIS
Director, Science Service

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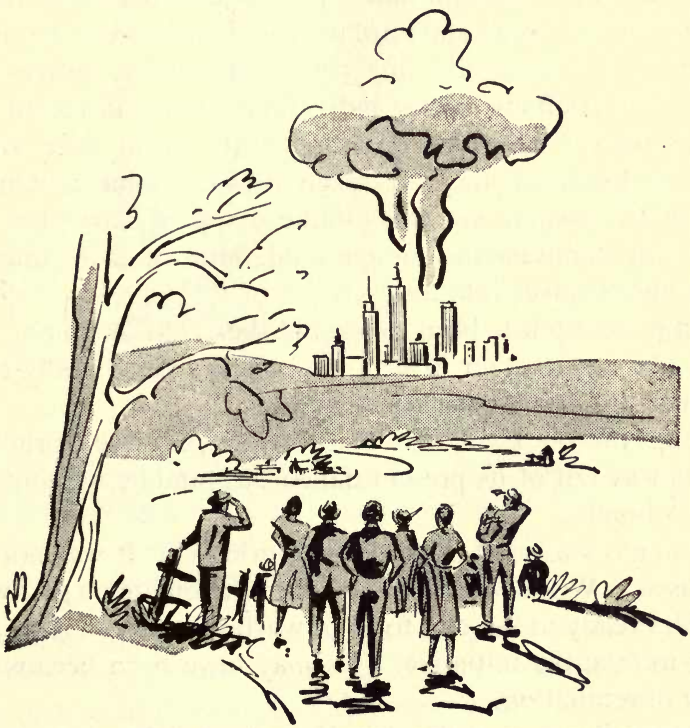
Introduction

LIFE WILL GO ON

Millions upon millions of the world's population today are fearful of A-bomb attack. Hanging over our heads is the atomic sword of Damocles.

There are some things that we can do about this danger. That is the reason for this book. It tells the facts about the sit-



Millions upon millions of the world's population today are fearful of A-bomb attack—

uation. Knowing the facts, all of us can face them more effectively. Unknown dangers are greatest.

Most important is a conviction that each of us must keep before him: Come what may, the world will continue in its orbit, peopled by human beings who will carry on the civilization so painfully evolved through the ages.

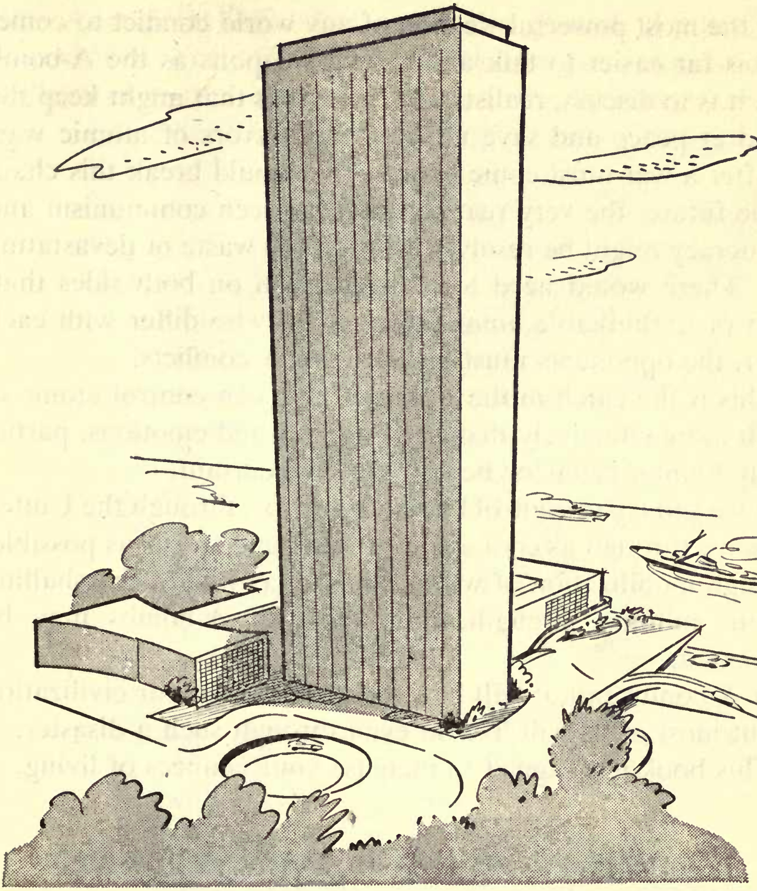
Great disasters have come to the earth from time to time. There was the Black Death of the Middle Ages, when bubonic plague was relatively more devastating than the bomb on Hiroshima. Each day a certain number of us are killed in automobile accidents, railroad and airplane wrecks, drown in the rivers and the seas. Some die lingeringly of cancer, others are murdered in conflicts among individuals. Never in recent history has there been a day on which war, big or little, widespread or localized, has not taken its toll. Some in China, India, and elsewhere are this minute dying of starvation, literally dying of not having enough food. Some of us in America are eating ourselves into an early grave.

Each generation is born, lives and dies. The A-bomb, if it comes, like any disaster, will prune human lives. Finally each of us must die. It is a question of timing.

Perhaps this book will save your life. Perhaps the world will work its way out of its present dangerous muddle without the use of A-bombs.

Poison gas was used in the First World War. It was not actually used in World War II because of a stalemate on gas, with both sides ready to use this form of warfare but both sides not willing to take the initiative. This may have been because of the fear of retaliation.

For a similar reason the dreadful use of A-bombs may be delayed or indefinitely postponed.



If we can try to control human behavior through the United Nations, the falling of A-bombs may be prevented—

A-bombs are merely one of the new potential tools of warfare that threaten our future. There are biological weapons, germ or bacterial warfare. There are newer kinds of poisons, such as "nerve" gases and the radiological weapons or "death dusts" that are A-bomb by-products. But A-bombs are prob-

ably the most powerful weapon of any world conflict to come.

It is far easier to talk about such weapons as the A-bomb than it is to discuss, realistically, measures that might keep the world at peace and save us from the horrors of atomic war.

After a war must come peace. If we could break this chain in the future, the very real conflicts between communism and democracy might be resolved without the waste of devastating war. There would need to be realization on both sides that, short of unthinkable annihilation of all who differ with each other, the opponents must reconcile their conflicts.

This is the catch in the situation: We can control atoms so much more effectively than men's minds and emotions, particularly human behavior behind the iron curtain.

If we can try to control human behavior, through the United Nations, through as cool a war of ideas and words as possible, through mobilization of world opinion, as well as marshalling of our military strength, the falling of A-bombs may be prevented.

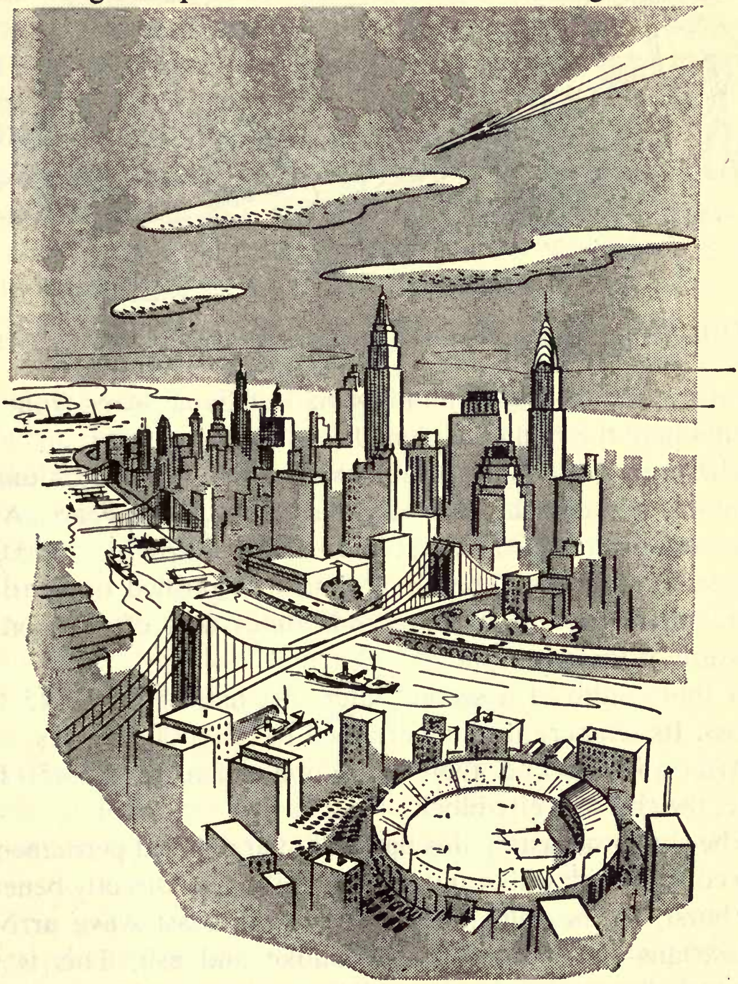
If A-bombs fall, it will be another failure in our civilization —but most of us will live on even through such a disaster.

This book is designed to increase your chances of living.

1. WHAT AN A-BOMB WILL DO

Out of the sun a black, cigar-shaped object falls toward the earth. At the edge of town a filling station attendant sees it cross the slice of sky between the car above him and the edge of his grease pit. The center fielder of the visiting baseball team sees the moving spot, then looks back toward the batter, impatient for the third out. A woman in the park hears a strange, thin whistle and looks up, shading her eyes.

At a point 2000 feet above the ground, the first atomic rocket of World War III explodes over your city. In one vast flash of light, equal to 100 suns, the buildings are etched



At a point 2000 feet above the ground, the first atomic rocket of World War III explodes over your city—

Light buildings and homes are totally demolished by the blast—

against a sky of fire. A blinding ball of flame leaps from the point where the rocket exploded.

There, in a millionth of a second, a lump of plutonium or uranium, perhaps the size of a basketball, disappears. As it vanishes, the temperature at that point jumps to 1,000,000 degrees Centigrade. The air around it is pushed outward by a pressure hundreds of thousands times that of the normal pressure of the atmosphere.

A thousandth of a second later, the ball of fire is 45 feet across. Its temperature has dropped to 300,000 degrees.

After a full second, there is a globe of flaming air 450 feet wide, the size of a city block.

The shadows cast by this ball of fire are etched permanently into concrete sidewalks and granite buildings. Directly beneath the burst, in the split second before the blast wave arrives, pedestrians simply vanish into smoke and ash. This is the point which atomic scientists call "ground zero." Here the sidewalk temperature is between 3,000 and 4,000 degrees.

With the sheer flash heat comes another form of radiating energy, the only one which a conventional high-explosives bomb cannot match on its smaller scale: Nuclear radiation, X-rays of the A-bomb, invisible yet striking through concrete and steel to destroy the single human cells in bone marrow, blood and living tissues.

Then the blast hits. A moving wall of shock crushes the city under a giant hand, wrenches it from its foundations, levels a mile-wide area into rubble. Small masonry buildings are engulfed by a pressure wave and collapse completely. Light buildings and homes are totally demolished by the blast. Factories of steel are stripped of roofing and siding. Only twisted skeletons remain, leaning away from ground zero as though struck by a hurricane of stupendous proportions.

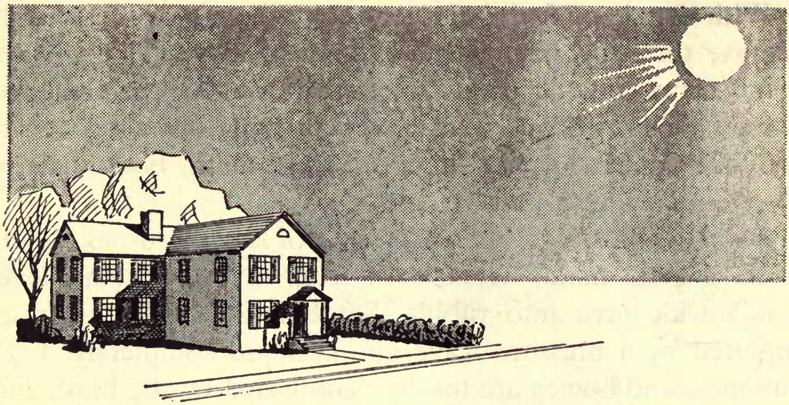
When the shock and blinding heat have gone, fire springs up in the wreckage. And billowing out in great clouds of dust, falling back to earth from the towering mushroom of smoke, there is the hidden terror which scientists call residual radioactivity.

What are these massive forces which an atomic explosion turns loose? How will they affect you?

ATOMIC FORCES

When energy is released suddenly by any sort of bomb, the rise in temperature of the exploding material causes complete vaporization of the bomb, casing and all. Solid matter suddenly turns to gas.

This gas is in a restricted space, pushing outward with huge pressure on the air around it. So great is this push that it can move air, water or earth, whatever is around the bomb when it goes off. The series of events which follow constitute



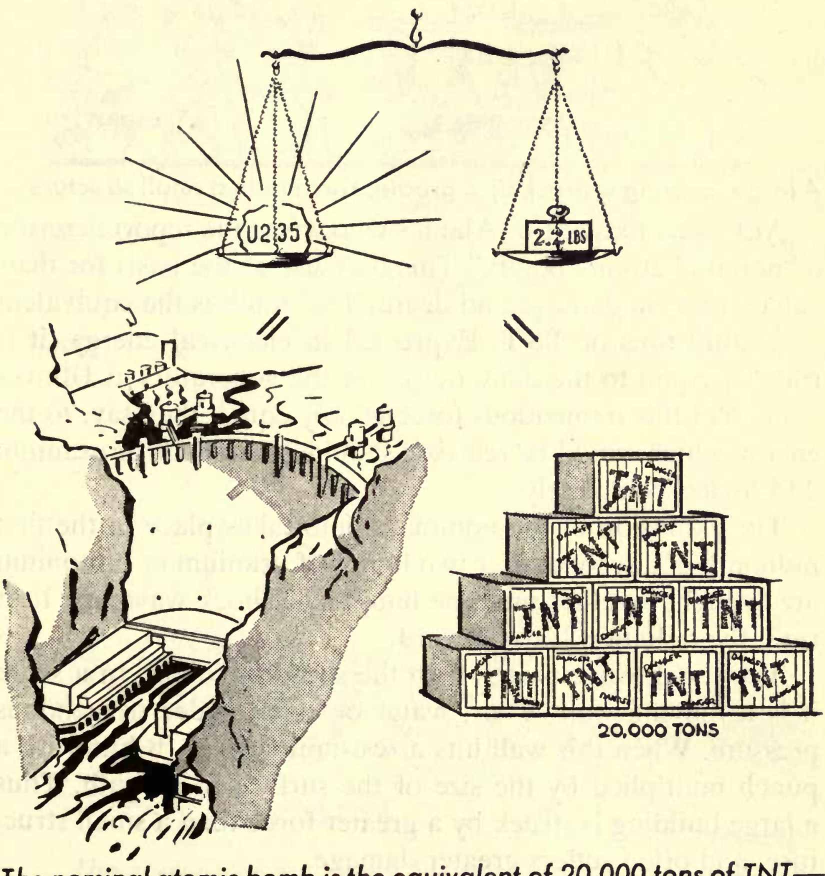
The tremendous heat generated by the explosion sends forth energy in a way which the scientists call thermal radiation—

the destructive blast of the bomb. In TNT and atomic bomb alike, blast does nearly all the physical damage by brute force. The tremendous heat generated by the explosion sends forth energy in a second way, which the scientists call thermal radiation. This is heat traveling with the speed of light, heat exactly like that given off by the sun. The rays are not penetrating. They are stopped by any object which stops light.

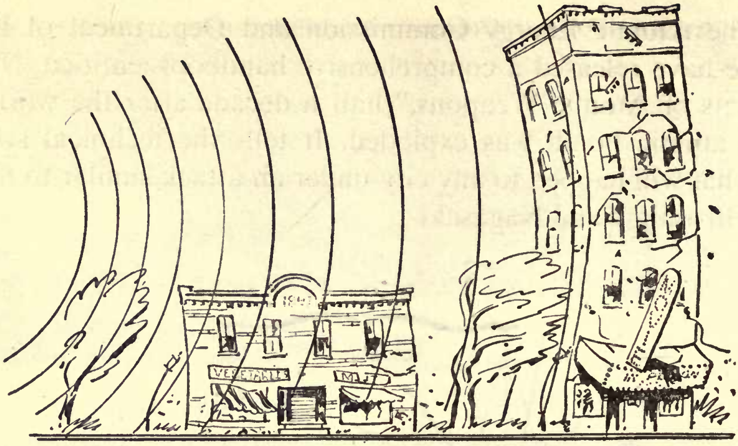
Alone in the atomic bomb, rays of nuclear fission channel a third explosion of energy. When the radioactive material of the bomb disintegrates, it releases various particles of electricity: beta particles, the atom's electrons; alpha particles, which are combinations of neutrons and protons; neutrons alone, the particles from the center of atoms; and finally gamma rays, which are high-energy rays very similar to X-rays.

The cumulative effect of these sources of energy is the measure of the atomic bomb, or of any other explosion of nuclear force, whether it be in the fission of uranium or the fusion of hydrogen in the "Hell-bomb."

The Atomic Energy Commission and Department of Defense have released a comprehensive handbook entitled "The Effects of Atomic Weapons," half a decade after the world's first atomic bomb was exploded. It tells the technical story of what will happen to any city under an attack similar to that on Hiroshima and Nagasaki.



The nominal atomic bomb is the equivalent of 20,000 tons of TNT—



A large building is struck by a greater force than a small structure—

AEC scientists at Los Alamos who wrote the report describe a "nominal atomic bomb." This they use as the basis for their calculations in damage and death. The bomb is the equivalent of 20,000 tons of TNT. Expressed in electrical energy, it is roughly equal to the daily output of the generators at Hoover Dam. Yet this tremendous force is only equal, they say, to the energy which would be released should 2.2 pounds of uranium 235 fission completely.

The explosion of the nominal bomb takes place in the first millionth of a second after two lumps of uranium or plutonium are brought together into one lump. The shock wave, the heat rays, the radiation leap outward.

The shock wave moves with the speed of sound. In a sense it is a moving wall of air, water or earth under tremendous pressure. When this wall hits a resistant surface, it hits with a punch multiplied by the size of the surface in its path. Thus a large building is struck by a greater force than a small structure, and often suffers greater damage.

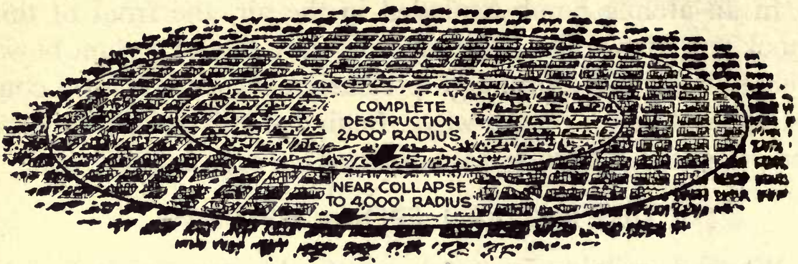
In an atomic bomb exploded in the air, the front of this shock wave is vertical. The high pressure hits as a giant blow. Behind the shock front, high pressure reaches back for a considerable distance on the wave. Behind that is a region where the pressure drops to less than normal, a region of suction.

DESTRUCTION FROM THE BOMB

When a building is struck by the blast wave, it is first punched on one side by the wall shock. Then, as pressure moves on with the speed of sound, it envelops the entire building, squeezing down from all sides. This pressure decreases rapidly, and is succeeded by suction which pulls wind, debris and people back toward the point of the explosion. With shock and suction comes wind of great speed, first away from the bomb, then toward it, adding to the havoc.

The great power of the atomic bomb produces so-called "mass distortion" of buildings. It engulfs and flattens whole

The pressure of the blast wave is succeeded by suction—



The area of complete destruction was about 2600 feet in radius—

buildings. The area of virtually complete destruction at Hiroshima and Nagasaki, where the bombs were approximately the size of the "nominal bomb," was about 2,600 feet in radius. Inside a circle swung on a line half a mile long, the area of almost total havoc covered three-quarters of a square mile.

The circle of severe damage, where buildings are wrecked to the point of near collapse, will reach out a mile, covering four square miles. From this point, damage will diminish with distance, depending to a great extent upon the weather and hills and valleys of the city. Even as far as eight miles from the blast, windows will break and plaster will fall. The overall area of damage will be about 200 square miles.

Buildings designed to be earthquake-resistant were found in Japan to have suffered remarkably light damage, even when relatively close to ground zero. Smoke stacks, tall and thin, were often by-passed by the blast. On the other hand, quirks of pressure produced by the atmosphere produced havoc far beyond the circle where it was expected. At Nagasaki, barracks nearly five miles from ground zero collapsed to ground level.

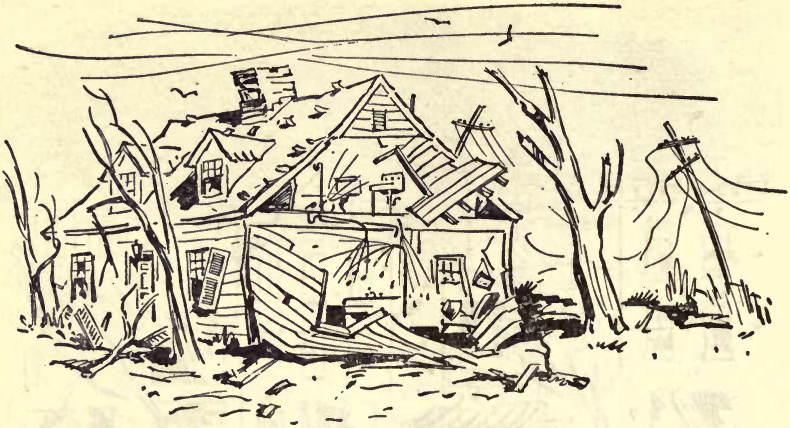
In the strongest buildings of reinforced concrete, pressure on the outside walls may cause the roof or floors to buckle. The walls facing the blast may be dished inward. There will be uniformly heavy damage to false ceilings, partitions and

Walls facing the blast may be dished inward—

plaster. Brick facings and cornices will be blown off into the streets, striking down the people caught outdoors.

Shed-types steel factory buildings will be bent over and blown apart, even when more than a mile from ground zero. Brick buildings, whose walls carry the entire load of construction, are among the most easily damaged. At distances up to 6,200 feet, they probably will collapse completely, taking with them everyone inside. Houses of wood at Hiroshima and Nagasaki were wrecked as far as 7,500 feet from the ground zero. The splintered wreckage kindled fires which followed.

Small steel-frame bridges were found to be quite resistant to blast, as were underground water mains, electrical conduits and gas lines. But damage to the water system through the breakage of pipes in houses and offices buildings will be one of



Damage to the water system through the breakage of pipes will b
one of the most serious effects—

the most serious effects of an atomic explosion. Overhea utility lines may be heavily damaged up to two miles from ground zero. Automobiles, buses and streetcars will be hi hard by blast and fire at distances up to a mile. In this country atomic scientists believe, reinforced concrete buildings will b generally less resistant to blast than Japan's earthquake-proo buildings. But tall buildings having heavy steel frames such a office buildings and hospitals, should withstand the effect o blast quite well. For American-built frame houses, it is believe that the radius of structural blast damage would not excee 7,500 feet—a mile and a half from ground zero—wherea at Nagasaki severe damage to houses extended out 8,500 feet We build our homes better.

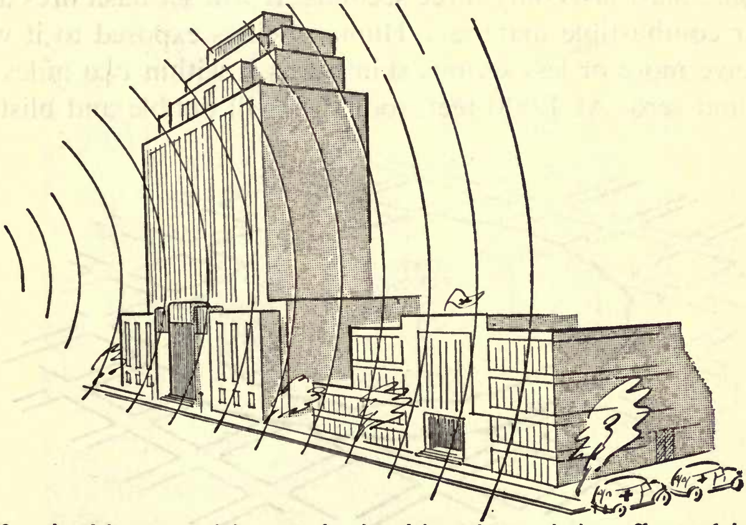
For an air burst over water rather than land, the shock wav is much the same. At Able Day at Bikini, ships suffered sever damage or were sunk 3,000 feet from the point directly be- neath the blast. Minor damage occurred out more than a mile

UNDERWATER OR UNDERGROUND EXPLOSION

In an underwater or underground atomic explosion, however, the action of the shock wave is entirely different. "There are no actual experiences upon which to base conclusions (about an underground burst)," the AEC reports, disregarding Soviet Russia's claim that it set off an atom bomb and moved a mountain.

Blast damage from an underground or underwater atomic explosion is expected to be less than that from an air burst. If a nominal atomic bomb were exploded 50 feet down in ordinary soil, a crater 800 feet across and 100 feet deep would be blown open. A bomb such as the Baker Day explosion, at Bikini, detonated underwater at shallow depths, would throw tremendous quantities of water into the air.

Both the soil and the water from such bursts would be in-



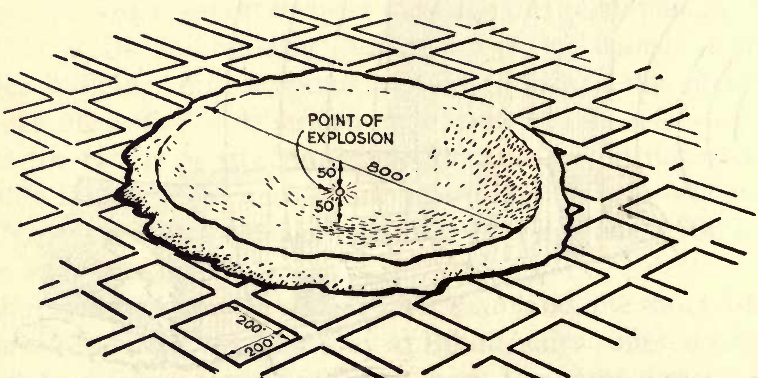
Office buildings and hospitals should withstand the effect of blast quite well—

tensely radioactive. In these two cases, danger from long-lasting radiation is expected to be greater than from any other source. The explosion's heat will be absorbed entirely by the material around it. And while blast damage will be done, the scientists have calculated the greatest blast damage is produced by a bomb exploded about 2,000 feet in the air.

EFFECT OF AIR BURST

At that height, chances of any one surviving within 2,600 feet—half a mile—are very poor, the scientists say bluntly. Persons within that circle will either be killed by the blast wave, crushed by falling buildings, burned to death or given a greater-than-lethal dose of radiation.

While the blast wave will take about 10 seconds to travel the two miles in which it does damage, the heat wave of an atomic blast lasts only three seconds. It will set flash fires and char combustible materials. Human beings exposed to it will receive more or less serious skin burns if within two miles of ground zero. At 4,000 feet, roof tiles will bubble and blister.

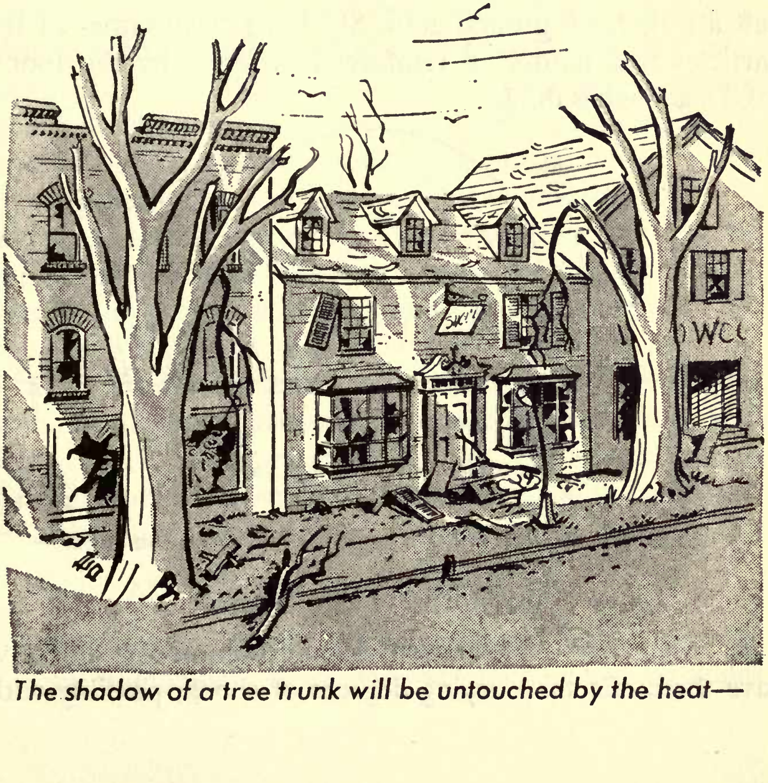


A crater 800 feet across and 100 feet deep would be blown open—

The heat will roughen polished granite, set fire to dark clothing and burn rubber tires a mile from the blast.

This radiant heat travels only in a straight line. Protection from it is afforded by almost any object. Clothing shields the body. The shadow of a tree trunk will be untouched by the heat. It is this phenomenon which produced the "profile burns" on buildings or human beings. It sears only where a surface is within line-of-sight from the explosion.

Burns from flash heat and the fires produced by the heat caused more than half the deaths and three-quarters the injuries at Hiroshima and Nagasaki. There were no fire departments after the explosions. Water pressure in the city mains was

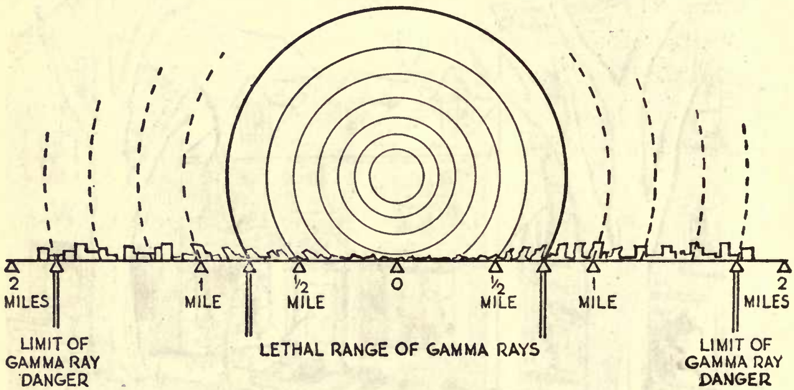


The shadow of a tree trunk will be untouched by the heat—

practically zero. Twenty minutes after the blast came the "fire storm," wind blowing into the holocaust from all directions, blowing 30 to 40 miles an hour at its height.

This is not all. The atomic scientists estimate that at 3,000 feet from the bomb's burst, there is better than 50 percent chance you will be killed by nuclear radiation, even if you are shielded by 12 inches of concrete. This is the effect of the deadly rays you cannot see. Neutrons and gamma rays are the dangerous particles of energy in this wave.

Gamma radiation (X-rays) from a nominal atomic bomb will kill at 4,200 feet from the burst. Neutrons are not quite so far-reaching, but they will deliver a lethal dose as far as half a mile from ground zero. Shielding from either of these particles is a matter of reinforced concrete by the foot, or solid lead inches thick.



Gamma radiation will kill at 4200 feet from the burst—

RADIATION SICKNESS

A lethal dose of radiation from the immediate blast will have these effects: Varying degrees of shock, possibly within

a few hours; nausea, vomiting and diarrhea in the following day or two; then fever. Often there will be no pain in the first few days, but merely discomfort, depression and fatigue.

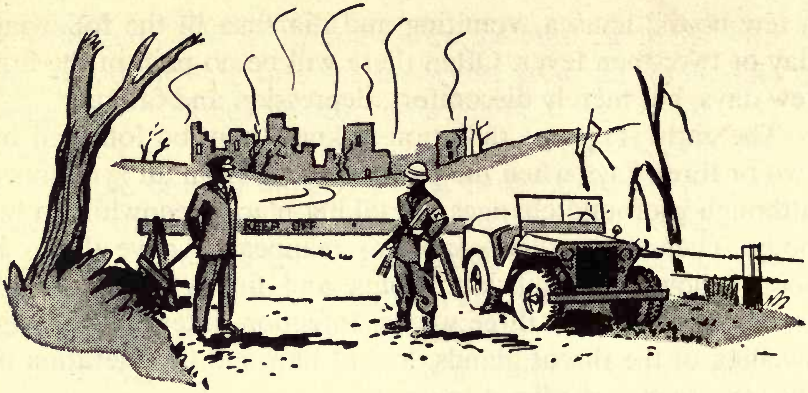
The early stages of radiation sickness may be followed by two or three days when the patient is free from all symptoms, although profound changes are taking place meanwhile in his body. Then the earlier symptoms reappear. Active illness is soon followed by delirium, coma and finally death, which comes within two to three weeks. Infection, internal bleeding, swelling of the throat glands, loss of hair and degeneration of the sex organs are all apt to occur.

AEC scientists and genetics experts are extremely cautious in discussing one vital question: Will the children and grandchildren of atomic victims be human monsters? Chromosomes and genes, biological factors which control heredity, are changed by radiation. But how much are they changed? Is there serious danger that these changes can be passed along to the next generation, or those which come after that?

Risk of passing on any changes in the chromosomes can be reduced if atomic victims "refrain from begetting offspring for a period of two or three months following exposure," the reports states. However, this precaution probably would not lessen the chances, if they exist at all, of passing on changes in the genes. Until large gaps in man's knowledge of radiation and its genetic effects can be closed, admit the scientists, estimates of what can or may happen in this field from atomic explosions will be little better than guesses.

AFTER-EFFECTS OF BOMBING

Will the bombed city be left an echoing ghost town, too "hot" with radioactivity to be entered? If the bomb explodes



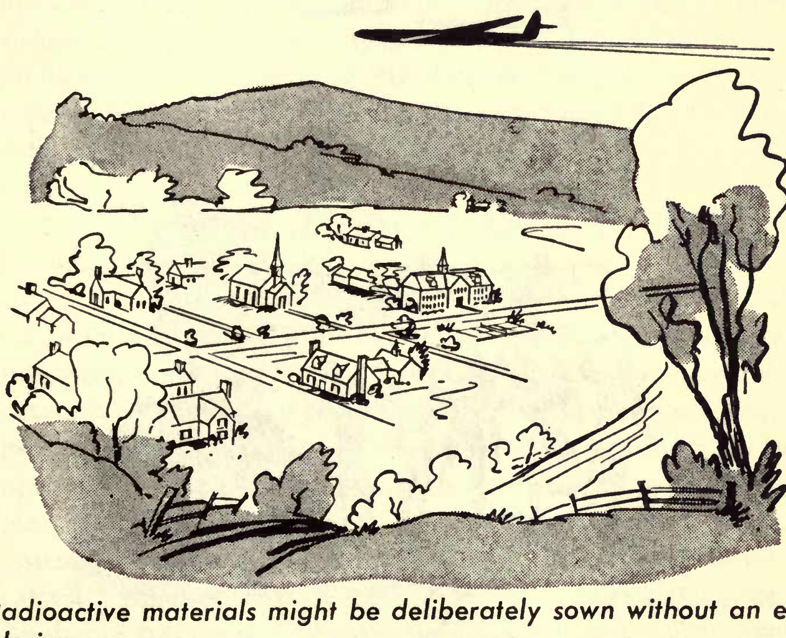
Will the bombed city be left an echoing ghost town—

high in the air, the AEC report says, this hazard will be very small. The radioactive residue of the bomb itself will fall to earth, but the small amounts of these fission products and the wide area over which they will be dispersed lead military men to discount almost completely any real danger from them.

Some dirt and dust will be sucked up into the boiling cloud of an atomic explosion, but this too will travel far and come back to earth spread over many miles. However, the "base surge" of water from an underwater explosion, or the great clouds of dirt thrown by a bomb exploded at street level or beneath the surface, will be intensely radioactive. Lethal levels of radiation in the wake of such bombs are possible and must be guarded against, the scientists warn.

If an atomic bomb were a fizzle, unexploded radioactive material might settle over a limited area in high enough concentrations to be dangerous. Such fizzles are possible. If the two lumps of fissionable material do not come together just right, the bomb might explode only partially, breaking apart and scattering its substance into the air.

Radioactive materials might be deliberately sown without an explosive taking place, as a new weapon of war. Such materials can and are being made constantly in the normal operation of atomic piles. Small amounts of certain elements can be made to give off tremendous amounts of radiation when so treated. If these were to be spread uniformly over a limited area, that area might be denied for human habitation for a considerable period of time. Those who remained within the area would be poisoned in much the same way that nuclear radiation from an exploding bomb strikes the human body. Even if great numbers of people are not directly killed, even if large areas are not laid waste as by direct atomic explosion, the panic-inspiring potential of radiological warfare as a "mys-



Radioactive materials might be deliberately sown without an explosion—

tery weapon" makes it a grim possibility which must be taken into account in civilian defense planning.

The blast of an atomic bomb is more violent, but methods of dealing with explosion damage, fire and rescue of the injured were developed long ago, and are not changed by the mere fact that an atomic blast is stronger than ordinary TNT explosions.

But in combating the radioactivity that comes with atomic bombing, new hazards and new ways to meet them must be planned for. Rescue crews and monitoring teams must have

Panic is a major danger of atomic bombing—

instruments to show them where dangerous levels of radioactivity have been left. They must know the length of time a human being can remain in buildings and rubble-strewn areas left radioactive. They must know new techniques of decontamination.

They must know how to deal with panic, for scientists are agreed that panic is the major danger of atomic bombing. "Mass hysteria could convert a minor incident into a major disaster," they say.

The first atomic bomb at Hiroshima killed 78,150 people. This is far from a "minor incident." But if an American community—anywhere—were atom-bombed, panic would strike 80 out of 100 of the physically unharmed survivors. Tens of thousands of thousands of Americans might be struck down by sheer terror, making vastly more difficult the job of meeting atomic attack. The great industrial centers of the nation might suddenly become empty shells as the people fled from A-bombs yet to come.

2. WHAT YOU CAN DO IN CIVIL DEFENSE

You have a job to do in defending your home, your home town, your country against an A-bomb attack, when and if it comes. Whether it be a full-time paid job, a volunteer job or just the things you must know how to do on your own, is not important. What is important is in knowing what to do and, then, doing it.

Strangely enough, for every citizen to know what to do is in itself a form of civil defense. It is the helpless, the people who do not feel needed who are the causes of panic. And panic

is one of the big dangers in an A-bomb attack or in any kind of a disaster.

What is your job?

That depends on the kind of person you are, where you work, what you like to do ordinarily.

First, there are the special agencies found in every city and town. These, and the people who work for them will be of vital importance in any A-bomb atack.

If you work for the telephone company, for the electric company, for a street car or bus line, for the water system, the gas company, a radio station, the railroad, the city government, or even the zoo, you will probably have an important job to do.

Every citizen must know what to do in the event of an A-bomb attack—

Radio engineers will keep communications open to the rest of the world—

If and when an A-bomb falls on your city, the water pressure must be kept up, the fire equipment must be mobilized, communication must be maintained—there are a myriad of important functions which must be kept going.

Right now, in many American cities, the public utilities have completed plans for what they will do in case of an A-bomb attack. Water companies know what valves to turn so precious water will not drain away through broken and twisted pipes. You, if you work for the water company, might already be assigned a valve to turn if the bomb should happen to fall in a particular area.

In all the public utilities there will be specific jobs to do to keep things running where possible, to provide substitutes where that isn't possible.

Telephones, where the lines stay intact, will be vital for communication between important offices in the target city and to other cities which can provide relief and places where refugees can stay. If you work for the telephone company, yours will be an important job when and if an A-bomb comes.

But radio engineers—hams and professionals—will probably be the persons upon whom your home town must rely to keep communications open to the rest of the world. Emergency wave-lengths are being set aside for communications in case of disruption of regular channels. Radio hams will be vital links in the emergency radio networks.

You will notice that the transmitters of your home town radio stations are not usually where the downtown offices are, they are on the outskirts of town. Most of them have their own stand-by power units, to be used if the regular sources of supply are put out of commission. This is a most fortunate thing, and the men who work there will be essential cogs in our defense effort if and when an attack comes.

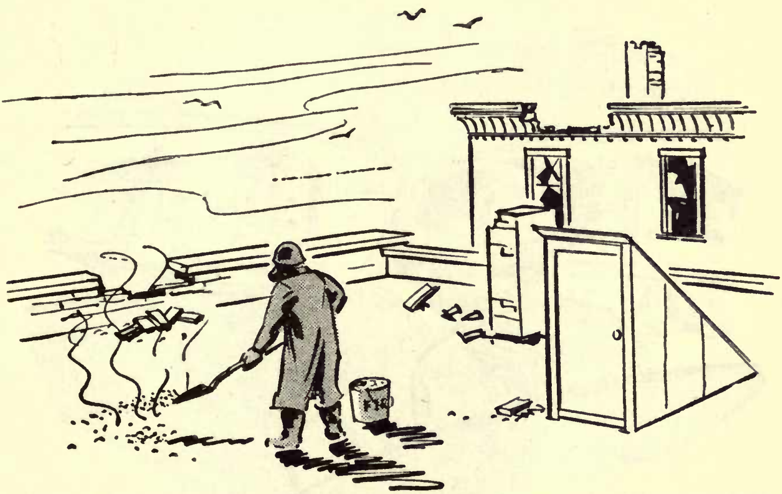
Keeping the gas and electricity going, or shutting it off where necessary will be important too. If you work for the gas or light company, you will have a big responsibility to your home town. The enemy will be wanting to kill people only as a secondary matter. What he is really after is to knock out your home town as a going concern—if he knocks out the sources of power he will be doing a good job.

CIVIL DEFENSE

This is what civil defense is aimed at—keeping your home town a going concern—keeping it providing the regular needs of the people who live there—keeping it providing the tools of war and the necessities of life which it is expected to produce.

Therefore, not only in the water, gas and electricity plants, but also in the factories, in the offices, in the government bureaus in your home town, there will be civil defense organizations. It's this simple—keep things running so far as you can.

This means that you—where you work—will be assigned to some job to do in case of an A-bomb attack. You may be assigned to go up to the roof immediately after some kinds of attacks, armed with bucket of sand and shovel or with a chemical fire extinguisher to see that a fire does not get started and put your building out of commission. You may be assigned to the first aid station to take care of people cut with flying glass or knocked in the head by falling masonry. But in all the tasks for which you will be trained, the objective is the same—keep the country running, fade with the knockout punch the enemy was expecting to deliver to us.



You may be assigned to go up on the roof armed with a bucket of sand and shovel—

VOLUNTEER JOBS IN CIVIL DEFENSE

Outside of your jobs, your places of work, there will be, of course, many tasks to perform. Volunteer jobs in civil defense may be expected to be broken down in much the same manner they are broken down by the British. They are, after all, old hands at the game.

You will probably find many jobs to do, many jobs for which to be trained, in your local civil defense headquarters. Communications must be kept open so civil defense workers may be deployed to the areas of greatest need, so supplies medical and food, may be sent where they will do the most good. This means volunteer work on switchboards, with raido transmitters, as couriers in cars, on motorcycles and on foot.

Where communications are down, or are scanty, there will be need for special reconnaissance work, for people who will

There will be need for special reconnaissance work—

go out to find out the extent of the damage from any attack, to determine its boundaries, its seriousness and to make estimates of what is needed from that information.

No new agency can be set up, whether voluntary or permanent, city, state or federal without its "bureaucracy," its administrative workers. Typists, teletypewriters, file clerks, secretaries—and supervisors for those people—they will be needed, both as part time volunteers and as full time workers.

The public must be kept informed and there are two phases to this job. The first phase is the preparatory one—telling the public what they can do, what they can expect, giving people the maximum amount of information before an attack occurs. This is the way democracy works. In the second phase, put into operation only if and when an A-bomb falls, public information will be the vital and specific job of directing the public so

Thousands are already trained in the use of detection instruments—

they do the things which will save their lives and keep them out of the way of life-saving efforts on the part of others.

Volunteers will have to know how to identify the different kinds of radioactivity and their extent. They will be attached to civil defense headquarters so the public, the rescue workers and the firemen will not have to risk their lives needlessly. Here we are ahead of Great Britain—this is natural because we have the A-bomb and thousands of our people have already worked with radioactive materials in Oak Ridge, Hanford and other places, including almost every university.

Thousands are already trained in the use of detection instruments, and they are trained to teach others. This is a job you might well be doing for your local civil defense office.

THE WARDEN'S JOB

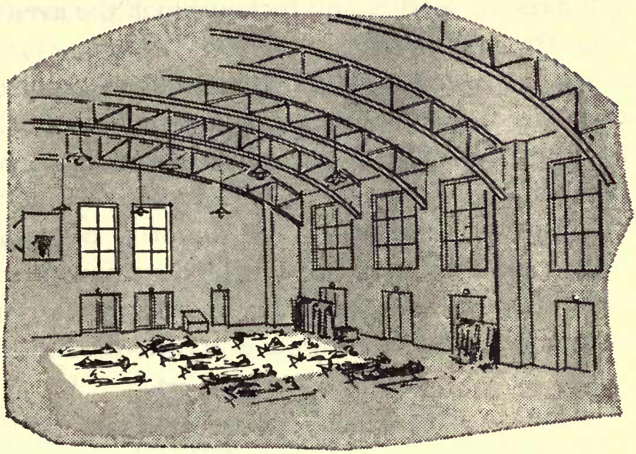
We will have air raid wardens again—but if you are a warden your job will be more complex. The wardens will, once more, be responsible for the organization of people in blocks, in apartment houses in neighborhoods. The wardens will be responsible for knowing how many people are in his area, where they are—so that an estimate can be made, in the event of an A-bomb attack, of who are safe in shelters, who are away from the area, and who remain to be rescued from the rubble.

The wardens will see to it that the air raid warnings have been heard and have been heeded, that everybody will know where to go when a warning is sounded, or, if they have specific jobs, will know what to do.

The British have a polite word for one of the most important of a warden's jobs—"incident control." The warden will be the man in charge if any "incident" occurs in connection with an A-bomb attack. He will be trained in what to do,

whether to call on outside help, whether to enlist volunteers from the neighborhood, or whether to ignore the whole thing.

An "incident" can be the falling of rubble across the entrance to a family air raid shelter, or it can be the panicking of the residents of a large apartment house. It will be up to the warden to know how to handle any kind of an incident.



People who have lost their homes must find shelter—

The warden will be concerned, too, with the movement of refugees—a horrible word for Americans to get used to. But, if and when an A-bomb comes near your home, there are two alternatives—either people in your area will need to move on to find shelter, or people who have lost their homes will be moving in with you. These people are refugees.

The warden will have to know, if an A-bomb has destroyed parts of his area, how many refugees will be leaving. And he will have to know, if his area is not destroyed, how many refugees it can take.

RESCUE WORKERS

Rescue workers might well be called the skilled workers of civil defense. It is not a matter of just clawing away at falling rubble until you get to a trapped person. Rescue work calls for high discipline and technique. It is obvious, for instance, that clumsy clawing away at rubble might bring more rubble down upon the rescue worker and further block the avenues of escape for the trapped victims.

If and when an A-bomb comes, thousands of trained and skilled rescue workers will be needed. You will have the opportunity to train for this difficult but rewarding assignment.

The government is hoping that at least 20,000,000 of us will take first aid courses. Except for the minority of casualties who will have radiation sickness, the larger number will be injured in familiar ways—burned, hit by falling masonry, in shock. Elementary treatment of these everyone should know.

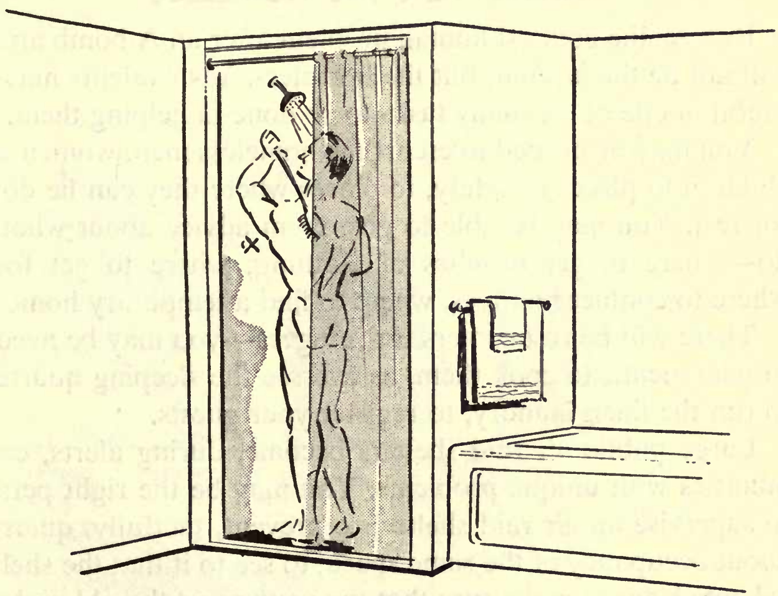
Rescue workers will have to know first aid and stretcher bearing—

Rescue workers particularly will have to know first aid and stretcher bearing. Another job for you in which first aid will be particularly important is driving an ambulance.

The British have the appropriate word for everything. One section of their civil defense corps organization is called "pioneers." In a sense on which the British probably never figured, the word is apt.

Pioneer workers will be the first to clear the way for the new beginning of living after an A-bomb attack. Whatever we call them, they will be one of the most important parts of our American volunteer civil defense effort.

Pioneers will clear away the debris and rubble left by an attack; they will plant the explosives which destroy unsafe



Uninjured persons who may have come in contact with radioactive materials should thoroughly scrub themselves—

buildings. They will be in charge of the early decontamination of roads and highways so people may move about without fear. Decontamination of vehicles and clothing will be in their hands. They will see to it that uninjured persons who may have come in contact with radioactive materials thoroughly scrub themselves—one of the most effective first steps in decontamination.

They will go into blasted buildings to salvage what can still be used. Pioneers will make emergency repairs to houses and to fallen wires and broken gas and water mains. They will clear roads so refugees can be evacuated and the injured moved quickly to places of treatment.

CARING FOR THE HOMELESS

By size, the greatest human problem after an A-bomb attack will not be the injured, but the homeless. Your talents may be useful in one of the many tasks to be done in helping them.

You may be needed to escort the homeless men, women and children to places of safety, to places where they can lie down for rest. You may be able to give them advice about what to do—where to get supplies of clothing, where to get food, where to contact relatives, where to find a temporary home.

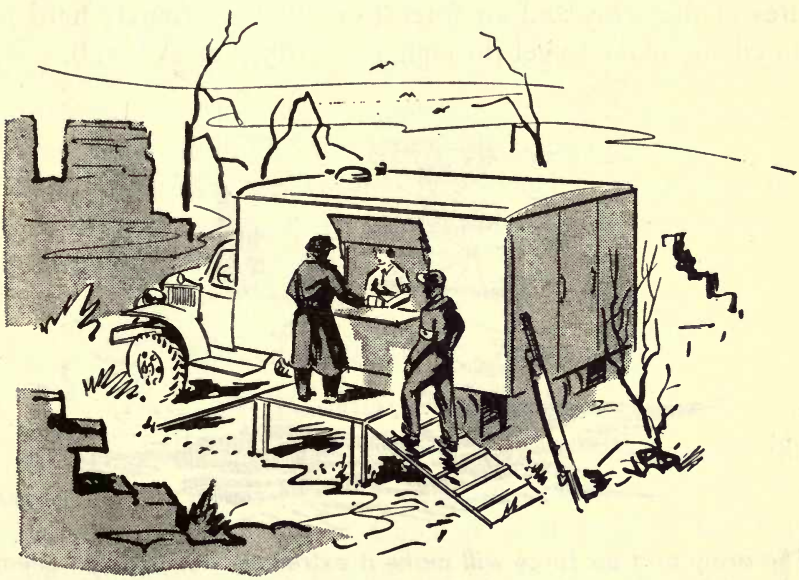
There will be rest centers for refugees—you may be needed to plan meals, to cook them, to oversee the sleeping quarters, to run the linen laundry, to register your guests.

Large public air raid shelters become, during alerts, communities with unique problems. You may be the right person to supervise an air raid shelter; to prevent, tactfully, quarrels about occupancy of the same space; to see to it that the shelter is kept clean; to make sure that the young and the old and the sick get the special attention they need. If you are that person,

it is likely that you will be elected by the fellow residents of your "community" air raid shelter.

Do you cook for a large family? Then you may be the volunteer answer to the question of where the other volunteer workers will get something to eat or a hot cup of coffee. There will be mobile kitchens to man for the purpose.

Along with the citizens who should learn first aid, there will be a great need of voluntary corps of hospital workers. Perhaps you were a nurse's aide, or a Red Cross grey lady during the last war. They will need you again and many more like you. In addition to training for work in the hospitals, persons will have to be trained to man emergency treatment centers, to take the place of, and supplement, hospitals which might be overcrowded or destroyed in an attack.



There will be mobile kitchens and need of people to man them—

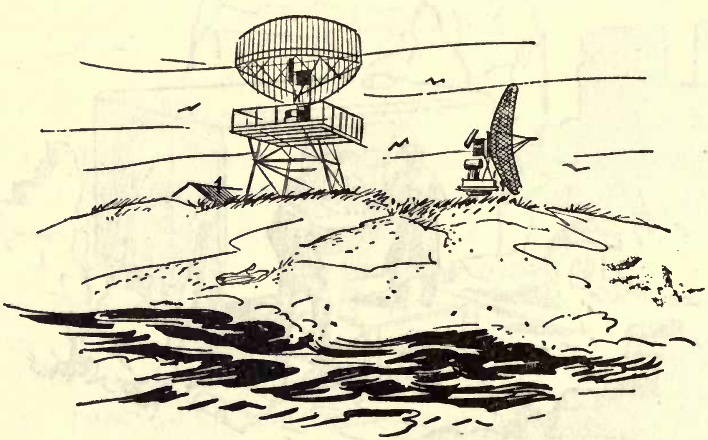
FIRE AND POLICE AID

An A-bomb sets fires immediately. The terrific heat blast instantaneously scorches everything within range that is inflammable. Then these fires begin to spread and other little fires, coming from gas tanks, stove burners left on in damaged houses, and from many other causes, start up.

Your fire department will need volunteers, many of them, trained to help them keep this danger under control.

The police, too, will need an auxiliary force. There will be a need to direct and control traffic, to maintain order, perhaps beyond the ability of the regular force to handle it. The precinct house communications will need extra manning.

Then there will be jobs connected with what the military call the "positive defenses" of your town. These are the measures of the army and air force to make it extremely hard for an enemy plane to get through and to drop an A-bomb.



The army and air force will make it extremely hard for an enemy plane to get through—

DEFENSE WITHIN THE HOME

Whether or not you can volunteer for any of these duties, your first responsibility will be your own home and those in it. A man's home is his castle, and it is his responsibility to make it as impregnable to attack as he can.

You may consider building a small shelter, if you are a home owner. It is estimated that many lives would have been saved at Hiroshima if the Japanese had taken to their very flimsy shelters when our B-29 was first reported overhead.

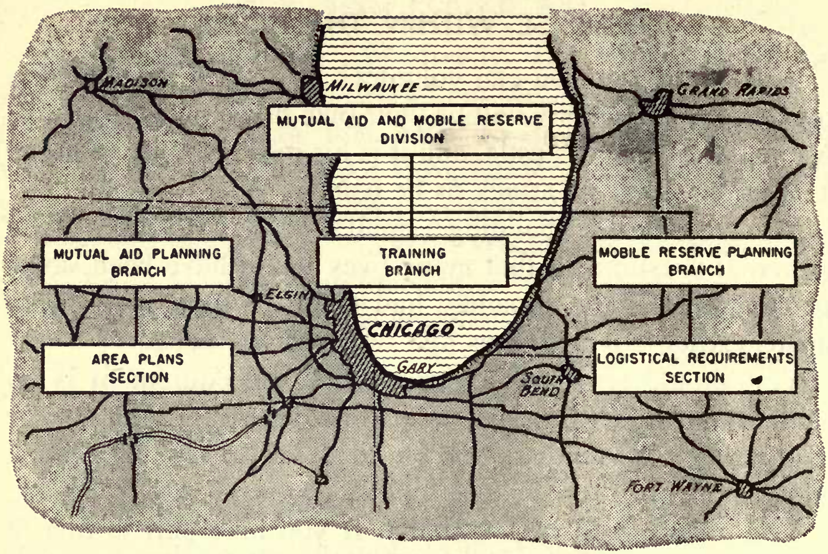
You should see that the proper first aid equipment is on hand. Your children should be taught where to go when the air raid warning is sounded. You see that everyone in your home understands instructions and follows orders in case of attack.

You have a final responsibility. If you take part in one of these many voluntary civil defense activities that final responsibility will be easy. It is to realize that there are many things that can be done to mitigate the effects of an A-bomb attack on your city—and to do your share of them efficiently.

If we all do that, we will do a great deal to keep down the effects of an A-bomb attack and to maintain the operation of our cities and our factories.

3. ORGANIZING AGAINST A-BOMB ATTACK

If Chicago's mayor were not on speaking terms with the mayors of Gary and East Chicago, Milwaukee, and all the cities of downstate Illinois—Chicago would be in a bad way should A-bombs fall on it. And the nation would be in a bad way too.



Mutual Aid and Mobile Reserve Division—

The primary purpose of an A-bomb attack has two parts: To knock out such vital installations as factories, communications centers, supply depots and the people who run them; and to knock out the resources, facilities and people who could put them back into working order.

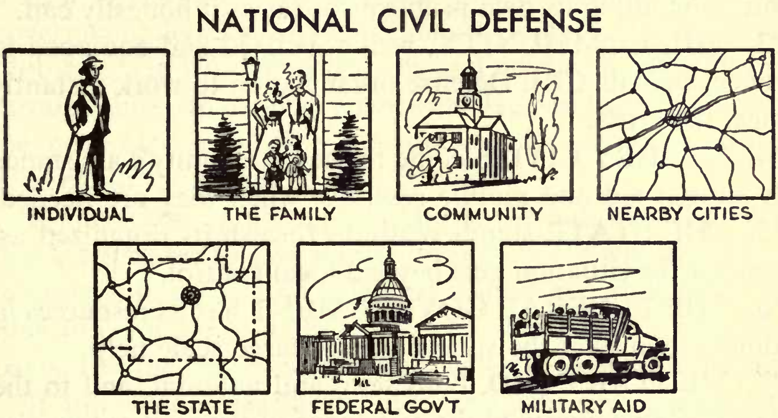
If Chicago could not depend on its surrounding communities for fire engines, water, doctors and medical supplies, emergency hospitals for casualties, rest camps for the homeless, rescue workers, Chicago would be a lifeless city after an A-bomb attack.

But if, under a well-set up organization and with plans properly worked out beforehand, the necessary—and only the necessary—aid is rushed into Chicago after such an attack, the dead and wounded would be much fewer, the extent of the damage from fire would be much less, and the ability of the

city to recuperate—to get going again on the war effort—would be much greater.

Thus civil defense requires a great deal of organizing and planning—nationally, statewise and locally.

An organization grows and changes when it is put to use. We may count on it that if we never have to use it, we will never have a perfect civil defense organization. Right now we have only theories, based on our untried civil defense organization of World War II and on the tried and tested British counterpart.



The American system of civil defense—

Paul J. Larsen, who is director of the Civilian Mobilization office of the National Security Resources Board—the agency responsible to the President for civil defense plans—puts the concept of American civil defense this way:

"Where do you start, in tackling this serious problem of modern civil defense planning for your cities?

"Fortunately, the natural line of responsibility and authority with which we are favored in this democracy is the basic

pattern for civil defense action in time of war. The prime mover is the individual citizen. Then in natural succession comes your local municipal government, then the state government and finally the Federal government.

"Here is a graphic outline of how this natural system of ours should operate in civil defense:

"1. THE INDIVIDUAL, calm and well-trained as possible does everything within his power to help himself and those around him.

"2. THE FAMILY, seeking self-preservation, operates as a unit in handling its own problems as far as it honestly can.

"3. THE COMMUNITY, well-organized and equipped in advance, puts its Civil Defense organization to work instantly to meet the crisis.

"4. NEARBY CITIES come to the community's assistance with mutual aid and mobile reserves, when they are needed.

"5. THE STATE stands ready to furnish its organized assistance if the situation gets beyond local control.

"6. THE FEDERAL GOVERNMENT has its resources in readiness to answer the state's call for large scale help.

"7. MILITARY AID, both state and national, and to the extent available comes to the assistance of the civil authorities ONLY after all other civilian facilities are exhausted.

This is the pattern, both for the planning states, and for the operating organization, if and when we need it.

THE NATIONAL DIRECTOR

Starting from the top down, there will be a Federal Director of civil defense.

The national government is operating on the theory that the less power this official has, the better; the more that can be

done by states and cities within themselves and in cooperation with each other, the better.

However, experience in Britain shows that, as the bombing attacks increased, the control from the top had to be tighter, the directions more specific. Britain even consolidated all her local fire departments into a national fire service so they could be sent to where they would do the most good for the national war effort.

So the pattern looks like this. In the planning stages of civil defense, the national director will be more of a coordinator than a director. He will achieve liaison between the various government departments, civilian and military, on civil defense problems. He will forward plans and advice to the states and, through them, to local governments. He will urge them to pass the necessary legislation, to conduct the necessary training courses, to set up the necessary staffs.

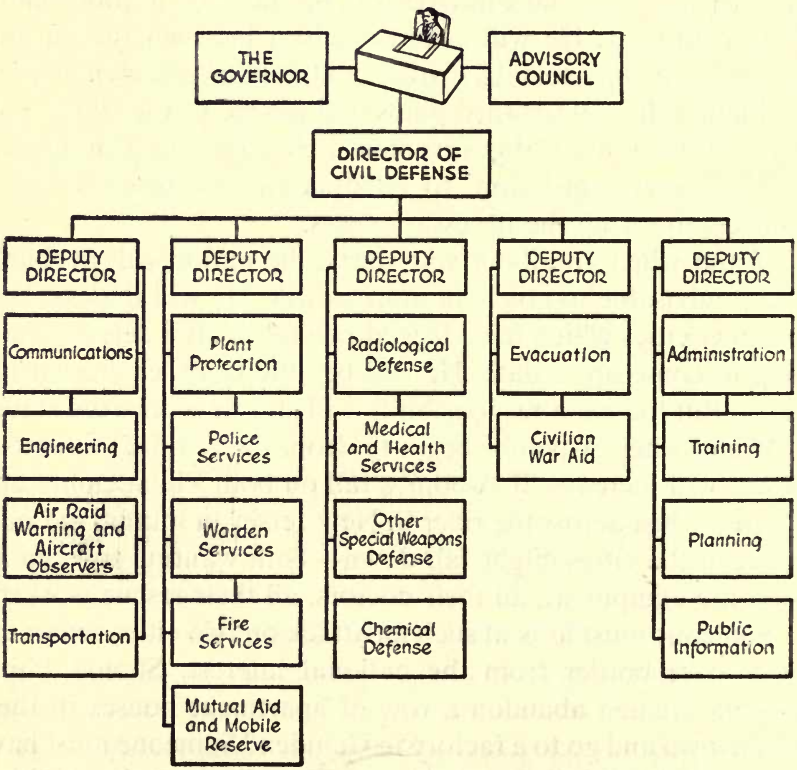
If and when an all-out war starts, the nation will probably find it advisable to give him more power. He will then be able to direct cities which have lagged behind in civil defense planning to come up to date. He will be able to order mutual aid pacts. But the main responsibility will still lie within the states.

If and when A-bombs begin to drop, the national director's power will increase. If A-bombs fall on both Philadelphia and Camden, just across the river in New Jersey, a mutual aid pact between the cities might fall down—both wanting to keep all their fire equipment, all their doctors, all their rescue workers.

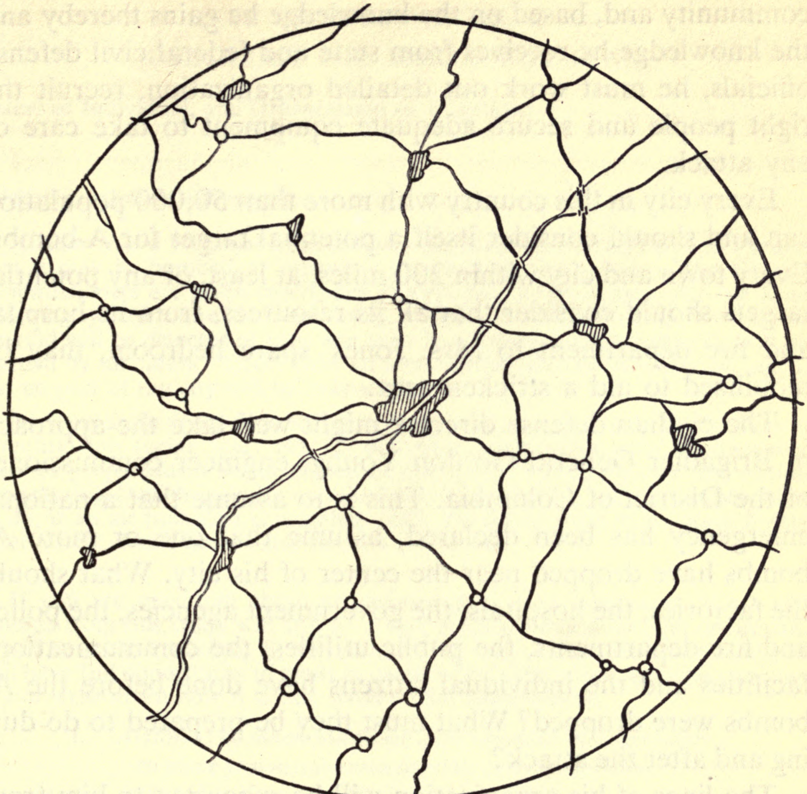
Someone must look at such an attack on two cities separated by a state border from the national interest. Should Philadelphia firemen abandon a row of apartment houses in their home town and go to a factory in Camden? Someone must have the position to decide and the power to direct such activities.

This person may, of course, be a regional director responsible to the national director.

Most states already have full time civil defense directors. They are responsible for more detailed plans and operations than is the national director, but, like him, they are still on the level of giving advice, coordinating the plans and operations of local communities. They will draw up and submit to legislatures mutual aid agreements between states. They will be responsible to see that the personnel trained under the national



Suggested model for state organization of civil defense—



Every city with more than 50,000 population may and should consider itself a potential target—

civil defense plan in radiation detection and other subjects pass on their training to men and women in the cities.

THE COMMUNITY DIRECTOR

It is in the communities where details of organization become more complex, where plans and advice from above are translated into realities. Your city director must survey your

community and, based on the knowledge he gains thereby and the knowledge he receives from state and federal civil defense officials, he must work out detailed organization, recruit the right people and secure adequate equipment to take care of any attack.

Every city in this country with more than 50,000 population can and should consider itself a potential target for A-bombs. Every town and city within 200 miles, at least, of any potential targets should consider that all its resources, from its hospital and fire department to Mrs. Jones' spare bedroom, may be mobilized to aid a stricken area.

The civilian defense director might well take the approach of Brigadier General Gordon Young, engineer commissioner of the District of Columbia. This is to assume that a national emergency has been declared, assume that one or more A-bombs have dropped near the center of his city. What should the factories, the hospitals, the government agencies, the police and fire departments, the public utilities, the communications facilities and the individual citizens have done before the A-bombs were dropped? What must they be prepared to do during and after the attack?

The lines of his organization will be suggested to him from the federal government. At the start he will need few full time workers, a few more part time workers and many volunteers. The kinds of jobs he will have to organize into a smoothly-running organization, ready to be mobilized in an instant, are outlined in Chapter 2.

He will have to see to it that the vital parts of the community's body are well prepared. A start in this direction is contained in the following questionnaire, which General Young asked the organizations in Washington to fill out.

CITY OF WASHINGTON, D. C.
CHECK-LIST FOR EMERGENCY PLAN

Name of Individual, and Organization or Function:..................................

....

Report(s) already submitted:..

Assume that a National Emergency is declared, and Washington is warned that it may be bombed or otherwise attacked on short notice. The District Commissioners are given emergency powers and ample money. An Air Raid Warning system is already functioning. You are to assume that any threatened air raid will be detected at least one hour in advance, and that the city will be warned by an "alert." Upon such an alert certain precautions may be taken, but no part of the city will be evacuated.

As soon as such an assumed emergency was declared, you would have a threefold job facing you: (I) To put your organization into a permanent state of preparedness for condition of emergency which the city and nation are entering (which includes anti-sabotage precautions). (II) To decide what to do, if an air raid alert is sounded. (III) To decide what to do immediately after a raid, if one occurs and the city is bombed.

* * * *

If you are uncertain about an answer, *give your best guess.* What will emerge from this study will still be a very tentative and imperfect document. It will be studied carefully by the National Security Resources Board; and you will have full opportunity to assist in perfecting it. Therefore, nothing you may say or write down now is in any sense a final commitment.

I. Action to be taken following a Declaration of Emergency, to place you in a permanent state of preparedness

1. *Additional Personnel.* Would you need any additions to your personnel? If so:

   a. About how many and what kind?

   b. Would they be needed to strengthen existing units, or to create new emergency units; if the latter, what units?

   c. Would you prefer to (1) recruit them yourself, and (2) to train them yourself, or would you like outside assistance in recruiting or training?

   NOTE: In answering the above, allow for the fact that some of your regular personnel may be casualties in an attack, and you may want to recruit and train replacements for them in advance. Also allow for the fact that, following an attack, you may need to make emergency repairs to your installations on a large scale and in a hurry, and may want an enlarged force to do it.

2. *Alternative Executives.* What plans, in general terms, would you make for "Number Two Men" to replace key executives and others following an attack, if the regular ones were incapacitated?

3. *Additional Equipment, Transportation and Supplies.* Would you need to lay in any additions to your present stock? If so:

   a. State what is needed, in whatever detail time permits. A list of at least the larger and more expensive items, or those hard to procure, would be helpful.

   b. To what extent could you get them locally?

   c. Would you need any financial or other assistance in obtaining them? (In the case of City Departments, assume that ample funds were available; but the availability of items for prompt purchase, and conflicting demands, must be considered.)

   NOTE: Here again, you should allow in your planning for possible destruction of some of your existing stocks in an attack; and also for the need of emergency repairs after an attack.

4. *Dispersed Storage.* Would you establish dispersed storage depots or dumps, away from the center of the city, for any equipment, transportation or supplies? If so, where; and what in general would be stored? (Indicate any *actually existing* storage of the sort. If confidential, omit details.)

5. *Space or Facilities for New Activities.* Is there any housing, storage, office space or other covered or open space, which you would need to obtain, or to have earmarked for you in advance, for use during an alert or after an attack? Indicate in as much detail as possible what, how much, where, and what equipment, supplies and special installations would be involved.

   NOTE: The outstanding examples of this are (1) space which the Emergency Disaster agency (a part of the Civil Defense organization) would need to house and feed refugees; and (2) space needed by the Medical organization for caring for casualties (including first-aid stations), pending the time when they could be sent to regular hospitals or evacuated from the city. There may be other cases of this sort in other agencies.

6. *Safeguarding of Documents.*

   a. Are there any documents, files, drawings, etc. which you would desire *and be able* to send *at once* to a point away from the center of the city? (*Yes* or *No,* no details needed.)

   b. If so, have you (actually, today) a suitable place where you could send them? (*Yes* or *No.*)

   c. Are there others which you could not send at once, but would wish to microfilm or otherwise reproduce for that purpose? If *"Yes,"* would it mean a large-scale, a medium-scale or a small-scale job of reproduction?

7. *Other Dispersion Preceding an Alert.* Are there any offices, shops, or other key installations or localized activities in central and exposed areas of the city, which you would move at once to less exposed locations; or, for which you would prepare, in advance, alternative locations, where the activity could be set up on short notice following an alert or a bombing? If so, give whatever details you can, including the new locations if you are prepared to select them or to make a guess about their location.

8. *Protective Construction.*

   a. Would you at once undertake any protective construction to minimize possible loss of life to your personnel on duty during an attack, and to minimize possible damage to key installations? If so, give whatever details you can.

   b. Would you need outside *assistance* (money, men or material) for the purpose? Specify.

   c. Would you need outside *guidance* as to suitable types of protective construction? Specify.

   NOTE: The foregoing does *not* apply to anti-sabotage precautions, but primarily to emergency construction designed to give some degree of protection from bombing or from widespread fires following a bombing.

9. *Sabotage.*

   a. Have you (actually, today) an adequate anti-sabotage plan? (*Yes* or *No.*)

   b. If so, would it be available on request to the proper District authorities, for study?

   c. Would you need any outside assistance (men, weapons, equipment or supplies), to put it into full effect? (If confidential, answer at your discretion.)

10. *Supplemental Communications.*

   a. Would you need to supplement your present communications (telephone, teletype, fixed or mobile radio, etc.)? If so, give whatever details you can.

   b. Would you need outside assistance (money, men, materiel, or action by other agencies) for the purpose? Specify.

   c. Have you checked any proposed use of radio with the Superintendent of Communications, D. C., to assure yourself that it would fit into the overall Emergency Plan?

11. *Passes.* Are there any categories of your personnel who should be provided with passes and identifications, entitling them to move freely about the city during an alert or following an attack (when normal movement may be restricted by the police)?

12. *Publicity.*

a. Following a Declaration of Emergency, is there any information you would wish to have presented to the public, to make your task easier or to assist the public? Specify in general terms.

b. Would you wish to utilize commercial radio for the purpose, and to what extent?

c. If the District Commissioners prepared, and periodically issued by newspaper or radio, "canned releases" to the public, is it likely that your material, or any of it, could best be incorporated in them?

13. *Drills, Etc.* Would you need or desire to participate in any city-wide drills, "practice runs," etc. (e.g., practice blackouts, practice alerts), and have you any comments or suggestions in this field?

14. *Other Communities.* Would you need to coordinate your emergency activities with those of adjoining cities and communities, and have you any thoughts about how this could best be accomplished?

15. *Other Organizations.* Same question, as regards other organizations or agencies *within* the District.

16. *Effect on Normal Activities.* Generally speaking, after a Declaration of Emergency and in the absence of any specific alert or warning, would the policy of your agency be "business as usual," or would there be any important restrictions or changes in your normal peace-time activities? Give any details you can.

II. Action to be taken when an air-raid alert is sounded (assumed to be a one-hour warning of a threatened attack)

17. *Mobilization of Personnel.*

a. What personnel, not on duty, would be immediately mobilized; and where? (Included both regular forces and any pre-arranged reserves.)

b. How would you get word to them to mobilize? (Among the possibilities are: (1) A radio signal broadcast; (2) Special calls, by telephone or other; (3) An advance understanding of what the personnel would do on hearing an alert.)

18. *Mobilization and/or Dispersion of Transportation and Mobile Equipment.*

Same questions as in (17) above. Give consideration to any equipment, or group of men, that you would wish to move out from the center of the city during the period of the "alert," so that they would be safer *during* a bombing, and therefore available *immediately after* a bombing to make repairs, restore service, open alternative centers of activity, or perform other essential tasks.

19. *Sabotage.* Would you need any immediate strengthening of the anti-sabotage measures already taken, to allow for the conditions of an air attack? (If confidential, so state.)

20. *Publicity.* Is there any information, pertaining to your agency, that you would wish to have included in any "canned releases" that the Commissioners would give out to the public *during* an alert (probably by radio)? Specify.

III. Action to be taken following an attack

21. What advance plans would you make, as to what your agency would do immediately after one or more bombs had been dropped on Washington? Give whatever details you can.

> *NOTE:* There is no way of telling in advance where the bombs might fall, what damage they might do, or how much of your own force and installations might be knocked out. You can only *guess* that the bombing would *most probably* be somewhere in the central part of the city.

IV. Other Questions

22. Are there any additional assumptions, information or data, which you have not been given, and which you will need before you can prepare a *final and permanent* Emergency Plan?

23. Any comments, criticisms or suggestions on any aspects of the subject would be welcome, either enlarging on the above items or on other items which we have overlooked.

GORDON R. YOUNG
Brigadier General, U. S. Army
Engineer Commissioner

There are some questions here which are applicable to almost all business and even to homes.

In Britain, wardens were laughed at before the bombs fell. In this country during World War II many people looked on some wardens as busybodies, officious and largely unnecessary. When the bombs dropped in Britain, the homes became the front lines and the warden became the man who knew how to direct the battle of the hearthside.

We were not attacked from the air during World War II. We may be this time. The civil defense director is responsible

for his wardens being properly deployed, being properly trained and that there are enough of them.

He must, through his city government, make mutual aid pacts with other cities, secure promises of help from suburbs and gear what outside help will be available into his plans.

This home army of civilians upon which all of us must depend if and when an A-bomb falls is not purely defensive. If we are in an all-out war, we will be expecting our armed forces to be carrying the fight to the enemy. They will depend on us to keep the supplies coming to them, to protect their loved ones, to keep democracy alive at home. We must be prepared, with an efficient defense organization to do that job.

4. KEEPING A-BOMBS AWAY FROM AMERICA

Far to the north in Canada, along the Aleutian chain in Alaska, on Greenland and Iceland, little teams of men with strange electronic instruments stand guard in the bitter cold of winter and the short, mosquito-tormented summer.

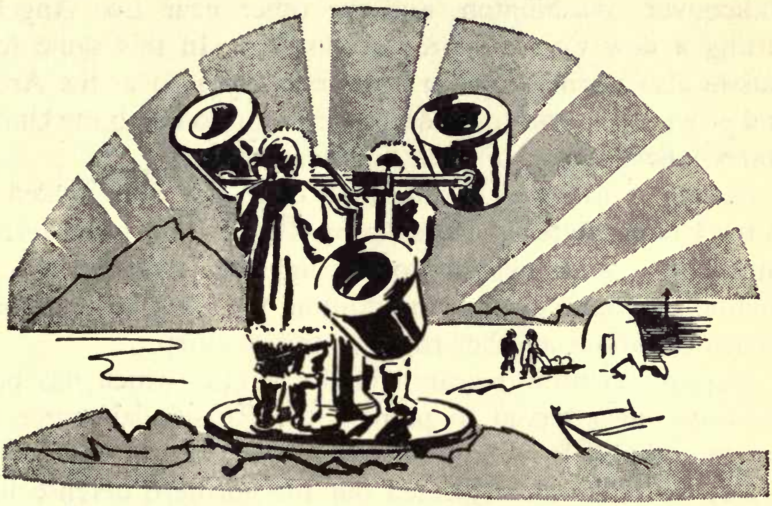
They probe the air 150 miles ahead of them, searching constantly for planes winging from Siberia or over the Arctic Ocean. Above them, and beyond them, fly American and Canadian planes patrolling our northernmost line of defense, constantly on the alert for the plane that shouldn't be there, the ship with the Russian accent.

There are three ways an A-bomb can get into position to be effective against us: 1. by plane or guided missile, 2. by ship, 3. in a suitcase carried by a man.

There are many methods of blocking all three paths of delivery. But they all depend on a vital net of communications,

starting far from our borders and ending up in information centers in your home town.

We have worked out ways of bringing down planes—even guided missiles—but we must know where they are and we must know soon enough to be able to do the job.



Far to the north, little teams of men with strange electronic instruments stand guard—

Before it was announced that the Russians had the A-bomb it was fashionable to declare that there was no defense against this awful weapon, that civilization would go up in flames and radioactivity if it were ever used. Now that the Russians do have this weapon, the pendulum has swung and it is fashionable to discount the weapon. The truth probably lies somewhere between the two—the A-bomb is dangerous, but there are things we can do about it.

The first thing our armed forces can do—although not first in point of time—is to bomb the factories where enemy

A-bombs are made and the factories where bomb carriers are constructed. That, however, will only come if and when a shooting war starts with Russia.

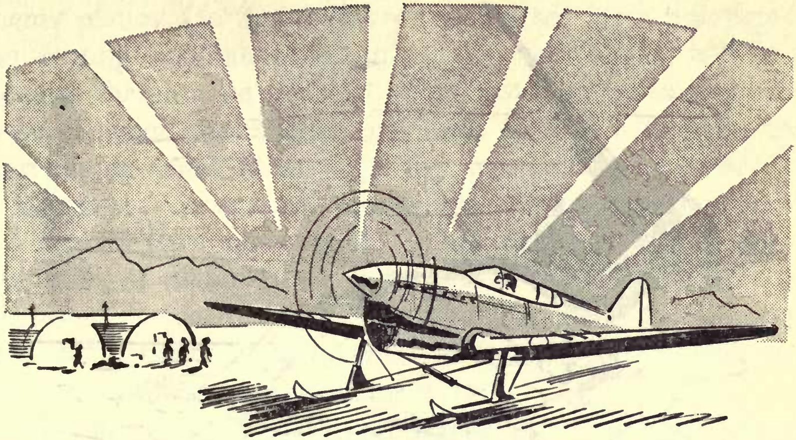
In June and July, 1937, two Russian single-engined planes took off from Moscow. They flew non-stop. One landed at Vancouver, Washington, and the other near Los Angeles, setting a new world record for distance. In this same feat, Russia also learned a great deal about flying over the Arctic and proved, 13 years ago, that if they want to bomb the United States, one way to go is via the North Pole.

During World War II, hundreds of planes were picked up in the United States and Alaska by Russian pilots and ferried into Siberia and then on to the fighting front against the common German enemy. In addition, the Russians learned a great deal about another route to this country.

Russian scientific research in the Arctic, which has been extensive, also served to prepare the Russian air force for bombing flights from Soviet bases to this country and return.

But we have not neglected our far northern defense line. Flights over the North Pole, once the subject of headlines, are now routine for our Air Force. Cooperating with Canada, we have established radar stations in many spots on the northern perimeter. Many of our troops have been trained to operate efficiently and with deadly effectivness at temperatures below freezing. Air bases have been constructed in Alaska and Northern Canada and planes modified so they can take off from cold snow-packed runways.

Next to carrying the attack to the enemy, our first line of defense against bombing attacks is our outermost guard posts, making a ring around North America through which the Russians will find it very difficult to slip without detection.



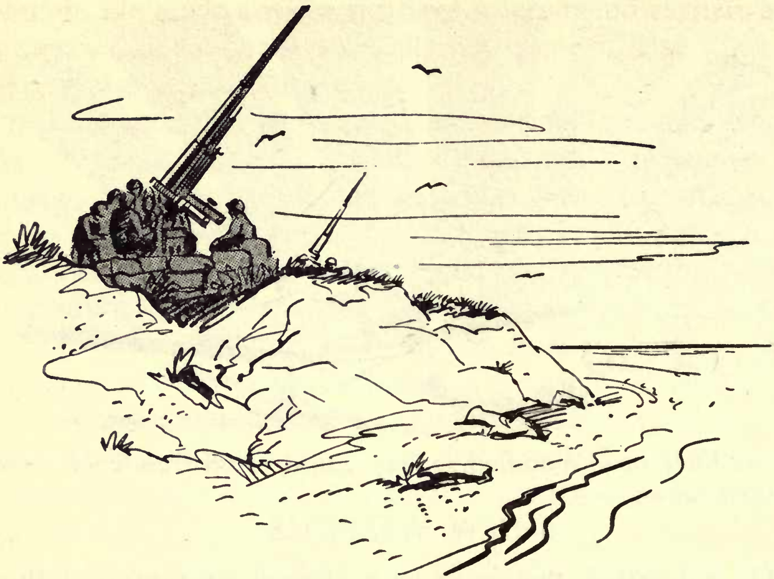
Planes have been modified so they can take off from cold, snow-packed runways—

NEW WEAPONS

Once detected, they must be kept track of. Ground radars, both on the outer ring and in a net of inner posts, will do part of that job. And, another World War II development which has undoubtedly been brought to even greater efficiency, will do the rest. That is the airborne radar.

Fighter planes—jet or conventional—equipped with radar will seek out the invader planes in the darkest night, through the heaviest fog. Carrying rockets, small cannon and machine guns and provided in sufficient quantity at the right time and place, they will make it hot for any invader.

From the ground, as any bombers which slip through approach our vital targets, will come the latest in anti-aircraft fire. Pointing a gun in the dark night at a place where a plane will be by the time the projectile gets high enough to hit it has become not a thing that man does, but only a thing that man sets going. Remarkable machines have taken over the



From the ground will come the latest in anti-aircraft fire—

job. And it happens much much quicker than you can say "Jack Robinson."

The things the large anti-aircraft guns shoot at the planes have changed too. Projectiles which change course in mid-air as their targets change course, projectiles which burst when they come a specified distance away from their targets—through use of a proximity fuse—projectiles with new, more dangerous explosives will be shot at the invading planes.

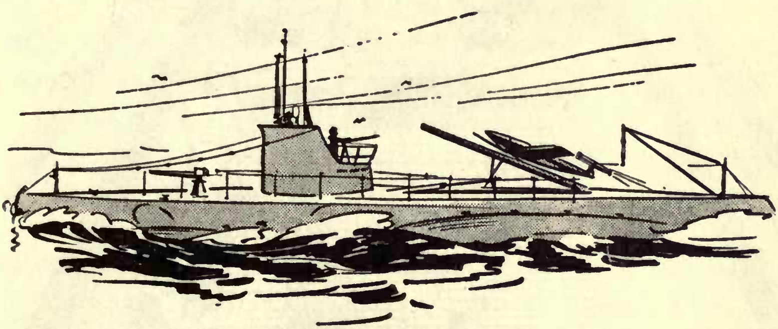
We are helped with these projects by the fact that the Russian planes, if and when they come, must come far. Plane designers must sacrifice speed to distance, or distance to speed; they cannot set two new world records with one plane.

During World War II most of our great cities were provided with a great network of searchlights to seek out and illuminate

enemy planes. On fine nights we would see them practicing, pinpointing our planes high in the sky. Searchlights will be a thing of the past. At the start of the last war, radar was used to supplement searchlights, was even used to help point the searchlights—now radar is all the illumination we need.

Planes can come from submarines which travel close in to our shores. How far into the future this is—for any great quantities of planes—isn't known. But there, the enemy, if he should decide to use this combination, faces not only our radar net once the plane is launched, but also the complicated anti-submarine measures of our navy.

It is not known what anyone can do about pilotless guided missiles which come from thousands of miles away—but, insofar as we know, they have not yet been developed to a point where anyone is getting serious about devising defenses against them. It is an old rule of war that every weapon eventually produces its answer.



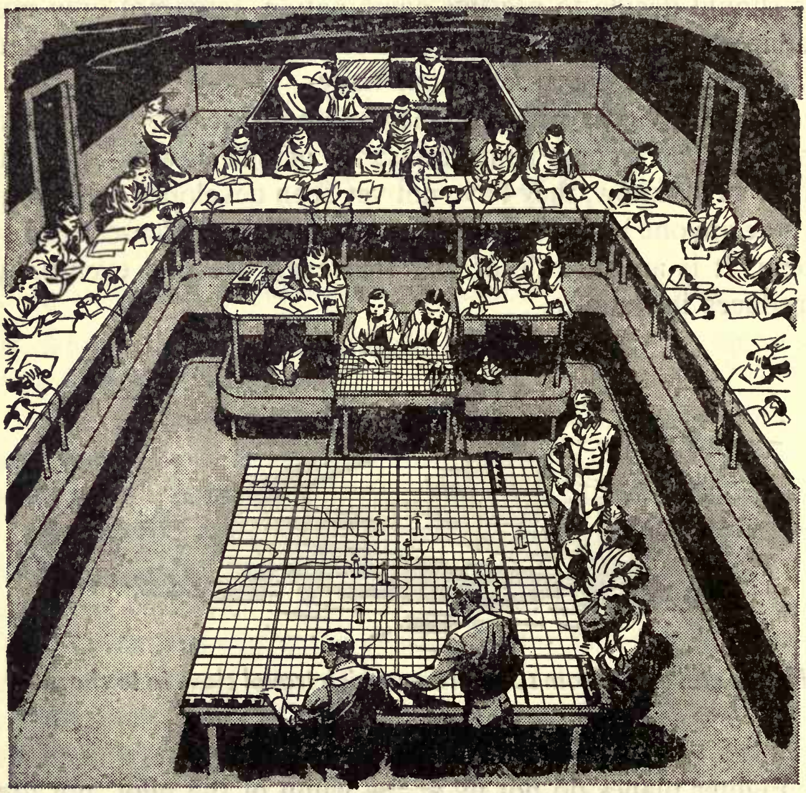
Planes can come from submarines which travel close in to shore—

INFORMATION CENTERS

Fighter planes do not fly at the whim of the pilot, nor are guns shot off when the crews themselves decide they can do the

most good. An elaborate network of communications will suck up all the information from our radar, digest it for our air defense commanders and transmit their orders to our planes and our guns.

In every possible target city there will be information centers operating 24 hours a day. Some have already been set up, some are on a stand-by basis. They will be connected with regional information centers and with each other. It is from these cen-



The paths of approaching enemy planes will be plotted on huge table maps—

ters that the air defense of our cities will be directed. The paths of approaching enemy planes and our own fighters will be plotted—perhaps electronically and automatically from radar information—on huge table maps. Air defense officers and all their liaison officers from other services will actually be able to watch the course of action on these table maps, almost as if they were watching a television screen. They will have under instant control all the forces necessary to fight off the enemy and, during combat, they will be in constant communication with our pilots, our radars and our gun crews.

One of the liaison officers assigned to an information center will be a civil defense official. From the air defense officer and from the table map, he will know when to alert a city, when to mobilize his forces against possible falling bombs.

Working in these nerve centers and manning the communications lines which keep them alive will be thousands of civilian volunteers. Thousands worked in similar places during the last war. If and when an A-bomb falls, it will not be merely a matter of tracking friendly planes and taking part in practice exercises as it was the last time. It will be the real thing—for the military forces and the civilians alike.

The control, supervision and inspection of ships entering our harbors have already been put into operation and will be tightened up even further if world tension increases. Discovery of an A-bomb before it goes off is difficult. They can be small —much smaller than the early models dropped on Nagasaki and Hiroshima. A Geiger counter or other radiation detector is no good.

But thorough inspection will still do the job. After all, an A-bomb is nothing you can hide in your hat. In addition, while one or two A-bomb carrying ships might get into one or two

A-bombs may be carried in over a land border in a suitcase—

ports without discovery, it would be hard to imagine a fleet of ships carrying enough bombs to make a difference in our industrial potential doing the trick.

The same principles hold true with the third method of bringing A-bombs into our country—carrying them over a land border in a suitcase. Customs inspections, border patrols already operating at reinforced levels will prevent most from getting through if the enemy should try this method.

It is important to realize that, while our defenses around our borders may be as tight as we can get them, while our weapons are up to date and our men eager, alert and well trained, if a determined A-bomb attack comes, we will not be able to prevent all the bombs from getting through.

A determined A-bomb attack will be one mounted in great force. Large numbers of planes, bearing large numbers of bombs and directed at many targets will come at once. The enemy will calculate whether he will lose too many of the precious and very expensive A-bombs before they reach their targets to make such an attack worth while. He will estimate

the effectiveness of our radar, our guns and our planes. Then, calculating what percentage of A-bombs might get through to their targets, he will estimate the effectiveness of our civil defense measures in getting our cities back on their feet again.

If he thinks the game will not be worth the candles—and these are most expensive candles—he won't come.

5. KINDS OF A-BOMB RADIATION

You are standing on an open, shadowless plain beneath a sun suddenly come close to the earth. From the searing sky, invisible bullets speed at you. Some are small, some large, yet all are so tiny you can neither see nor feel them when they strike. They leave no bullet holes, yet inside your body they are tearing apart the substance of muscle and bone marrow, exploding the individual cells of your blood, leaving a trail of devastation through solid tissue.

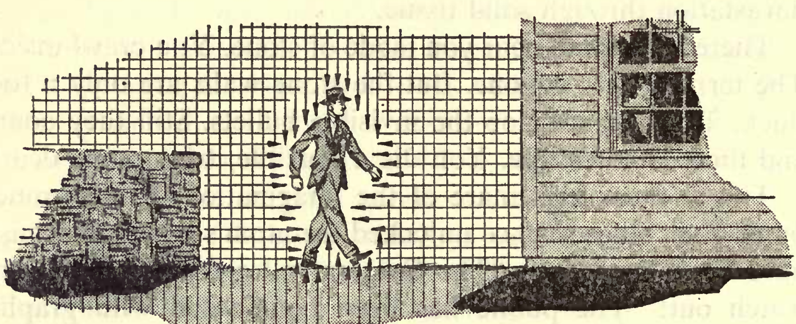
There is an igloo near you made of stone. You crawl inside. The terrible heat is gone. But the stone walls are only a foot thick. They cannot stop the invisible bullets. Still they come, and there is no escape. You die a horrible, frightening death.

This is sheer nightmare of the imagination. It is so much bunk. Ever since science unlocked the atom's power, alarmists have been screaming, "The Geigers will get you if you don't watch out!" The public has been bombarded with graphic descriptions of entire cities suddenly left echoing wastelands, of water supplies contaminated with invisible death, of men in gas masks and lead-lined suits moving slowly through an undamaged town waving the mysterious antenna of radiation counters. The nameless, gnawing fear which came to the world with the first atomic bomb is largely based upon this bogey—

Radiation. The bomb brought the greatest explosive blast that man has yet devised. It brought heat which etches shadows into granite. But these were familiar dangers, forces which had been released for centuries by ordinary bombs on a far smaller scale. The unknown, the new hazard to human life, was radiation. And fear walks the pathways of the unknown.

WHAT IS RADIATION?

Actually, you have been exposed to constant radiation since the day you were born. From outer space, particles of energy called cosmic rays are constantly bombarding the atmosphere. Some get through to the earth's surface. They pass through the walls of your home, through the top of your car, and into your body. You can hear these rays with a Geiger counter. The slow, unsteady clicking of the instrument is the sound made by cosmic rays. Atomic parlance calls it background radiation.



You have been exposed to constant radiation since the day you were born—

You are also barraged to a lesser extent by radioactivity from the earth beneath you. There are metals in the earth's crust, such as uranium or radium or thorium, which occur partly in radioactive form. These "isotopes" are unbalanced in

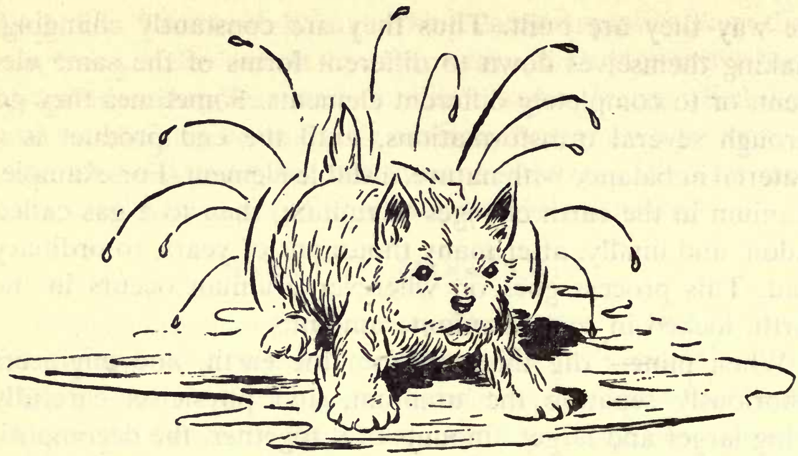
the way they are built. Thus they are constantly changing, shaking themselves down to different forms of the same element, or to completely different elements. Sometimes they go through several transformations, until the end product is a material at balance with nature, a stable element. For example, uranium in the earth changes to radium, then to a gas called radon, and finally, after many thousands of years, to ordinary lead. This process goes on wherever uranium occurs in the earth, locked in rock in minute amounts.

When miners dig this ore from the earth, and engineers laboriously separate the uranium, and physicists carefully bring larger and larger amounts of it together, the decomposition process can be speeded up. When the amount of the unstable type of uranium or plutonium passes what is known as the "critical mass," the coming apart process flashes through the individual atoms in a chain reaction, and there is an atomic explosion. What takes thousands of years in nature is made to happen in a millionth of a second in the bomb.

In whatever way this magic transformation occurs, there are thrown off tiny particles, together with rays of electrical energy, which account for the change in weight of the original unstable atoms. Even on this smallest of all scales, the fundamental law of conservation still works. Nothing is ever lost in this world.

Radioactivity is like a dog shaking itself after being in the water. The dog is wet and doesn't like it. He is "unstable"; so he shakes. The drops of water fly into the air. The dog is drier and thus happier. But that does not mean the extra water has disappeared. It is there on the ground.

Radiation is the rain of particles and energy from an atom shaking itself or being shaken by man. It comes in small drops



Radioactivity is like a dog shaking itself after being in the water—

and in larger drops and in the units of energy called photons. Ordinary light is made up of photon rays. So are X-rays.

Each individual particle or ray is indescribably small. Moving out from an atom, they can pass through air, whose molecules are far apart; through water, whose molecules are closer together; through steel or concrete or lead, whose molecules are closely crowded. Some of the particles can travel farther through these various meshes than others. Some can bounce off obstacles and keep going. Some will be stopped almost immediately. Fire a shotgun through a room full of medicine balls hung from the ceiling. Some of the pellets will get through. Throw a basketball through the same room. Chances are it won't go very far. The same happens to atomic particles.

When an atomic bomb explodes, there is a tremendous initial burst of radiation — that is, nuclear radiation as differentiated from the radiation of pure heat. After the explosion there is residual radiation. This is caused by the fission

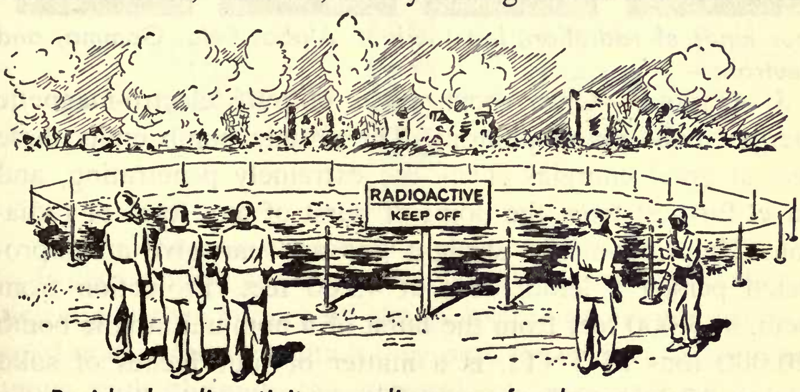
products of the bomb which fall to earth, and by the materials, dirt or water or steel, which were close enough to the bomb's explosion to be made radioactive by the initial radiation. Whereas the initial blast of radiation is over in a few seconds, the residual radioactivity may linger on for hours or days or hundreds of years.

INITIAL RADIATION

Different types of atomic bullets are sent off in the A-bomb's colossal blast. There are four kinds of radiation which are a hazard to human health if received in large enough amounts.

1. Alpha—Relatively heavy particles made up of two protons, each having one positive charge, and two neutrons, which have no charge. Alpha particles are so big they are like the basketball thrown into a room full of medicine balls. They are stopped in air in less than two inches. They can go only an infinitesimal distance in water. They are stopped cold by light cotton clothing, and may not even pierce the skin.

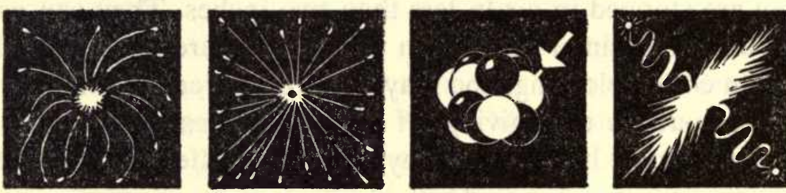
If radioactive dust giving off alpha particles is inhaled or eaten with food, however, it may have grave effects within the



Residual radioactivity may linger on for days or years—

body. If enough is absorbed in the system, alpha emitters can kill. Materials which give off alpha particles include uranium and plutonium. When an atom bomb explodes, most of the uranium or plutonium atoms do not break apart, but fall to earth. Poisoning by them is possible, but far from likely unless an enemy sows them deliberately.

2. *Beta*—Electrons moving at high speed. Because electrons are extremely light in comparison to alpha particles, they bounce off atoms and molecules in their path very easily. They thus have little effective penetrating power, even in the air. Those shot off from an atomic burst are not considered dangerous in themselves. But beta radiation is created by other forms of radiation striking stable atoms. If those atoms are within the body, beta will contribute to the over-all radiation injury.

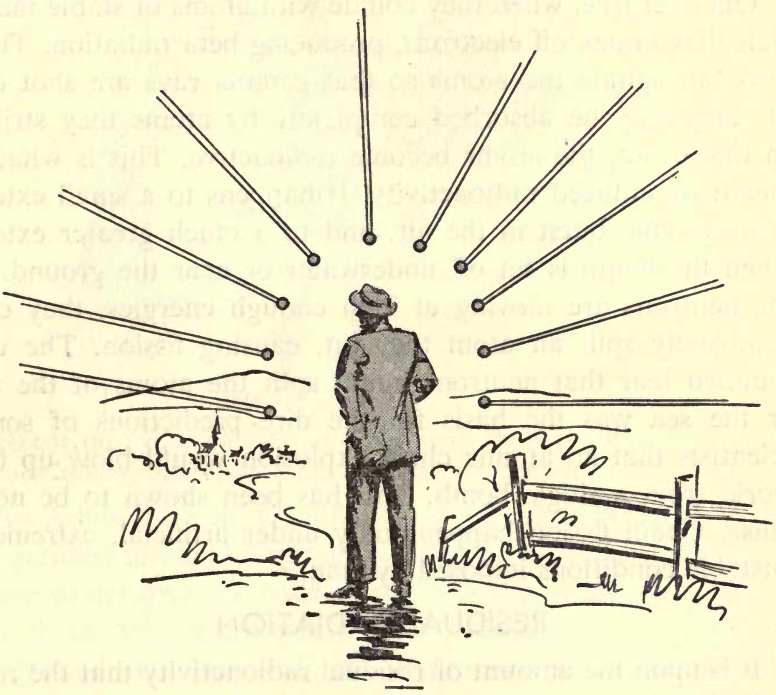


Four kinds of radiation, left to right: Alpha, Beta, Gamma, and Neutrons—

3. *Gamma*—Ultra short waves of pure electro-magnetic energy, made up of photons. The atomic bomb emits these rays at great energies. They are extremely penetrating, and travel farthest from the point of burst of any form of radiation. They move in a straight line and can give an unprotected person a lethal dose at 4,200 feet. Protection from them, at 3,000 feet from the burst of a nominal atomic bomb (20,000 tons of TNT), is a matter of four inches of solid steel or 12 inches of concrete. They can go right through the

human body, and leave a path of injured cells behind them.

4. Neutrons—Particles from the atom's center which carry no electrical charge, but which are 1800 times the size of electrons. A great burst of neutrons accompanies atomic fission. Like gamma rays, they can penetrate air for considerable distances and are a menace to the human body. They are the other major radiation hazard of the atomic bomb.



Neutrons are subject to elastic scattering—

Unlike gamma radiation (which are rays rather than particles) neutrons bounce off the molecules of the air, water or solid matter through which they pass. Thus they follow a tortuous path through the atmosphere—what physicists call

"elastic scattering"—and can come at you from any direction. Any sort of shield against radiation within the lethal range of neutrons—about 2,400 feet for a nominal bomb—must protect you from the rear as well as in the direction facing the bomb's burst.

Neutrons are released when an atom breaks apart. They are the bullets which produce a chain reaction.

Once set free, when they collide with atoms of stable materials they knock off electrons, producing beta radiation. They also can agitate the atoms so that gamma rays are shot off. Or they may be absorbed completely by atoms they strike. In that event, the atoms become radioactive. This is what is meant by induced radioactivity. It happens to a small extent in an atomic burst in the air, and to a much greater extent when the bomb is set off underwater or near the ground. If the neutrons are moving at high enough energies, they can completely split an atom they hit, causing fission. The unfounded fear that neutrons might split the atoms of the air or the sea was the basis for the dire predictions of some scientists that an atomic chain explosion would blow up the world from a single bomb. This has been shown to be nonsense. Chain fission happens only under artificial, extremely unstable conditions imposed by man.

RESIDUAL RADIATION

It is upon the amount of residual radioactivity that the real radiation danger of an atomic explosion is largely judged. This is not to say that you cannot receive a lethal dose from the first flash of the bomb. But if you are within radiation's death circle, it is almost certain that you will also be injured or killed outright by the blast wave or the heat of the bomb, falling

buildings or burning rubble. Another way of putting it: If, after an atomic bomb bursts, you can dust yourself off and walk away, there is not much chance of your having absorbed a deadly dose of radiation.

If you can dust yourself off and walk away, there is not much chance of your having absorbed a deadly dose of radiation—

An A-bomb burst at 2,000 feet in the air is believed to do the greatest physical damage to a target. At this height, blast is free to act over the widest area. But the height also means that there will be relatively little radioactivity induced on the ground, and the "hot" fission products of the bomb will be scattered over a wide area. Atomic Energy Commission scientists and Defense Department officers say there is little to fear from left-over radioactivity following an air burst.

It is in an atomic explosion underwater or under the ground that residual radioactivity might assume serious proportions.

Then the water or the earth surrounding the giant burst of neutrons is made intensely radioactive. It is thrown high in the air for the wind to scatter, covering the surrounding area with a thin layer of material which will produce dangerous amounts of radiation for days or even months. Radiation men will have to move in with their black boxes, and entire city populations may have to be evacuated for a time, fleeing an invisible menace which no one can see.

6. THE DANGER OF RADIO-ACTIVE POISONING

Radioactivity is a dangerous aftermath of an A-bomb explosion. The explosion itself can produce radioactivity in common materials close to the point of explosion, and an underwater blast would drench relatively large areas with dangerous spray and vapor. The atmosphere would be contaminated with debris of the A-bomb.

This sort of radioactivity would be dangerous enough, but there is a possibility that an invisible radioactive "dust sand" could spread over cities of the earth and kill their populations with radioactivity without the noisy warning of an A-bomb.

There has been less discussion about this specter of radioactive poisons than about the A-bomb itself. The famous Smyth Report of 1945 contained a brief reviewing paragraph on the danger. In 1948 an Austrian by the name of Dr. Hans Thirring discussed the danger. Official documents in 1950 alerted the American people with considerable brevity. The Atomic Energy Commission has reported that studies on the feasibility of radiological substances as a method of warfare are being continued. The official designation of this type of

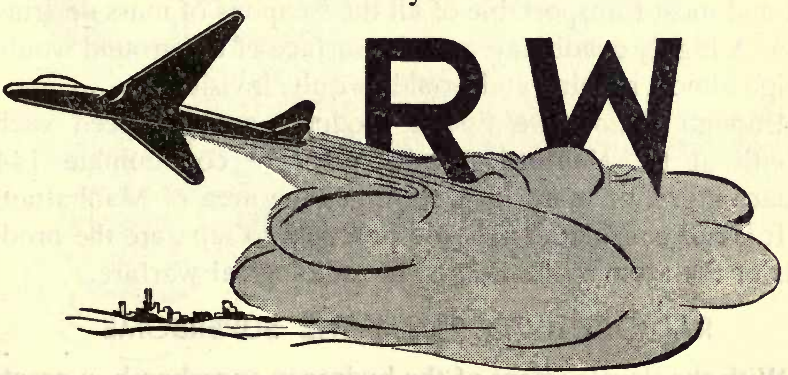
weapon is RW, standing for radiological weapon. Ex-Secretary of Defense, Louis Johnson, reported the possibility of RW as an outgrowth of atomic energy applications for national defense. He warned in an official report that every atomic pile of suitable size, irrespective of its design or purpose, is a potential source of a significant quantity of RW agents.

He told the American people that RW weapons could be made available in another country whether or not they produced an atomic bomb.

Obviously, RW is at present a "mystery weapon" to the dangers of which American officials are alert.

WHAT IS RW?

What would be done to prepare to use RW would be to collect the debris of smashed uranium atoms from atomic furnaces in which fissionable material is being burned. About a dozen of these products would be useful in warfare. These emit beta rays (electrons) or gamma rays of substantial energy, and half of their substance would be disintegrated in periods from about a week to a year.



Very fine sand coated with radioactive poisons could be spread thinly over the area—

Very fine sand would be coated with these radioactive poisons and spread very thinly over the area where it is desired to wipe out life.

The person in a poisoned area has no way of knowing that he is in danger either by the evidence of his senses or by any unsophisticated tests. He may receive a lethal dose of radiation before he knows that he is endangered, and yet a few days later he may die. Radioactivity detectors would tell of the danger. If a person is aware of the danger he may survive if he flees the area at once with a dampened handkerchief over his nose and mouth. Walls of a sturdy building or even heavy clothing would lower exposure risk, but half an hour of breathing of dust stirred up by passing winds would give a fatal internal dose.

Radioactive "death sand" because of its novel and unique properties may be useful in special situations, but its proper use in war would be very difficult.

The "death sand" is prepared by drying fission product salt solutions on sand or metal powder. It is described as the lightest and most transportable of all the weapons of mass destruction. A highly deadly layer on the surface of the ground would weigh almost nothing and would be quite invisible.

Enough radioactive fission products are produced each month at the Hanford, Wash., plant to contaminate 144 square miles, or more than six times the area of Manhattan.

It is not considered now too practical to separate the products of the atomic pile needed in radiological warfare.

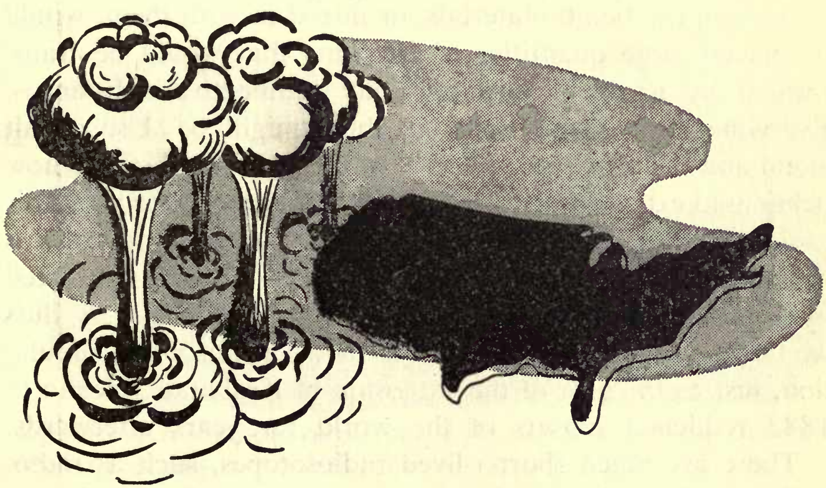
RADIOACTIVITY FROM THE SUPERBOMB

With the development of the hydrogen superbomb, a greater radioactivity danger to the world would be imminent.

Radioactivity from superbombs could completely destroy life on a whole continental area. That is one of the threats of the hydrogen bomb to our civilization. The complete destruction of a large city by one H-bomb is appaling enough. But experts see even grimmer possibilities in the radioactivity that can be produced by the superbombs.

Radioactive materials in great amount could be flung into the atmosphere if the conditions of the explosion of the hydrogen bomb were carefully selected. Actually the effects of neutrons and hard gamma radiation (X-rays) from a hydrogen bomb would not extend much father from the blast center than they would in the case of an atomic or fission bomb.

The debris of a hydrogen bomb would not be much more radioactive than remains of the uranium or plutonium bomb set off within it to trigger it. But a great blast of neutrons and other radiation would be produced, extremely intense within



Explode a series of H-bombs in the Pacific and radioactive winds could carry devastation across continental United States—

the explosion area. This radiation could be used to create radioactive poison contaminants of the atmosphere in large quantity. For many miles away from the blast and damage area fine particles of what amounts to "artificial radium" would fill the air and be transported on every wind, sickening man, beast and plants alike and wiping them out.

Explode a series of H-bombs in the Pacific and radioactive winds would carry devastation across continental United States. Lay down bombs along the line of the iron curtain and death would sweep over the U.S.S.R.

THE USE OF RADIOACTIVE ISOTOPES

The marvelous development of artificial radioactive isotopes, so useful in medical, biological and industrial research, tells how hydrogen and atomic bombs can be used for such poisonous, radioactive warfare.

Around the bomb materials, or mixed in with them, would be placed large quantities of elements that would be transformed by neutrons into intensely radioactive substances. Everyone knows what some of these might be. Use cobalt metal and the air will be filled with the radium substitute now being used extensively in hospitals for irradiating cancers. This radiocobalt lasts a relatively long time, since only half of it is radiated away in five years. The debris of a cobalt-reinforced hydrogen bomb would persist for years, and its deadly dust would be carried around the earth by the atmospheric circulation, just as the dust of the explosion of Krakatau volcano in 1883 reddened sunsets of the world for years afterwards.

There are much shorter-lived radiosotopes, such as radioiodine, made in the atomic reactors by neutron bombardment. Iodine's radiations wear out much faster, since its half-life is

only 13 days, but it is very intense at first. To an enemy population it would be a dangerous dose. It would bombard everything in the same way that, medically, it is now used to destroy and reduce the activity of the thyroid gland when it is overactive or cancerous.

Other artificially radioactive substances could be created in the hydrogen bomb blast. Some of them undoubtedly would be most effective for warfare.

Would our nation use such radioactive warfare? Would a potential enemy launch this new and insidious attack, just as the Germans started gas warfare in the First World War?

Against such radioactive poisons there seems to be little chance of real protection. It might wipe out life on the earth. Crops, animals, and all other living things would be affected. A fortunate few might be able to survive the attack by wearing protective clothing and masks to filter out the radioactive dust.

Against such radioactive poisons there seems to be little chance of real protection—

These are realities of the atomic dilemma that faces the world. In other nations, people and officials are asking the

same questions with the same indecision and gnawing fear, so far as they are allowed to know the facts.

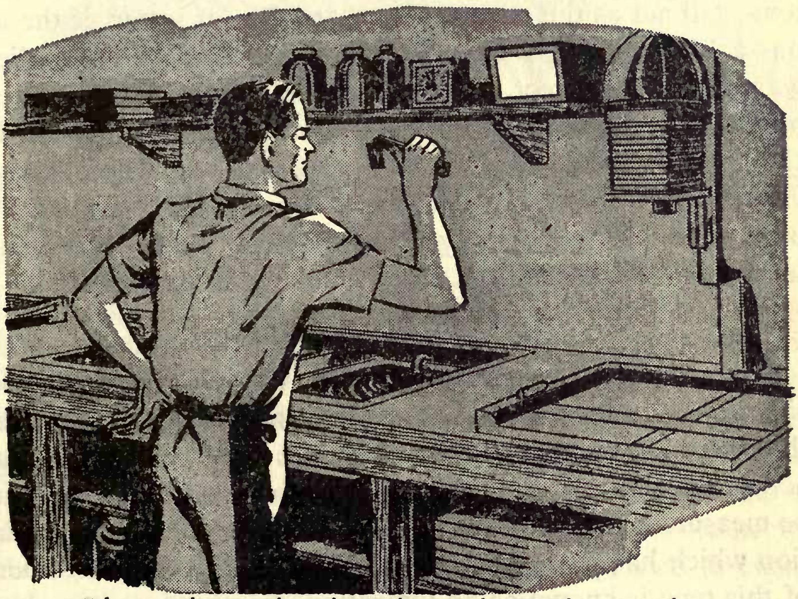
7. HOW TO DETECT RADIATION

Before it kills, carbon monoxide makes you drowsy. A physical wound breaks the skin and tears the flesh; pain answers in indignation and blood points to the wound. Fire sends heat ahead of it to lick at the surface of the body, and the nerves scream their alarm of danger. But against radiation, man's body has no natural defense nor even a warning system. Radiation can do irreparable harm, yet there is no sixth sense to tell you that it is striking. You can neither see, feel, taste, smell nor touch it.

Danger will be foretold by ingenious instruments—

How then are victims or potential victims of radiation to know whence or when the danger comes? The answer lies in a number of ingenious instruments which science is already using, and in others, still on the drawing boards, which may someday be an essential item in your own home. If atomic attack came tomorrow however, the real answer is that victims probably would not know. They would have to be told by fast-moving crews of radiation monitors using the complex instruments now available. These are man's artificial sixth, seventh and eighth senses.

Radioactivity has become synonymous in the public mind with the long-famous Geiger-Müller counter. Yet this electronic gadget is neither the oldest nor the most important of the indicators which now measure the atom's energy.



Film can be used to show that radiation has struck—

PHOTOGRAPHIC FILM

Radioactivity in general, and the X-ray in particular, were both discovered by the effect radiation has on photographic film. The chemicals in photographic emulsion are sensitive to electrically charged particles as well as to electromagnetic rays such as light. Thus film can be used to show — after it has happened — that radiation has struck. When the film is developed and evaluated by men trained in the art, blackening and fogging will give a rough measure of the amount of radiation which has fallen.

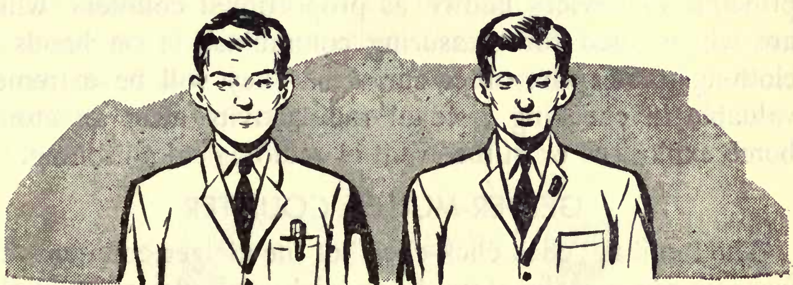
WILSON CLOUD CHAMBER

Radiation creates a path of electrically disturbed atoms in air through which it passes. These disturbed particles, called ions, will act as the cores for tiny droplets of water, if the air has a high enough water vapor content. One of the earliest ways found to detect radiation was in a container of super-humid air. The track of atomic particles passing through the chamber is clearly visible in thin streaks of fog. These atomic vapor trails were first observed in 1912, and have been widely used since then in the study of cosmic rays. But for measuring large amounts, the Wilson cloud chamber is not practical.

IONIZATION CHAMBERS

If ionization of air occurs between two poles bearing opposite charges of static electricity, a current will flow between the poles. As more and more ions are produced the charge across the gap will diminish. This drop in static charge may be measured, and is in turn a measure of the amount of radiation which has passed between the electrodes. An instrument of this type is known as an ionization chamber.

Simple and rugged devices built on this principle are now in use in American nuclear laboratories and atom bomb factories. Workers carry a tube similar to a fountain pen in size and shape. An even newer type is a capsule worn on the lapel. At the end of the day, these are collected and their electrical charges measured on an electrical indicator. The dose of radiation to which the worker has been exposed during the day can thus be determined. Like the strips of photographic film which the workers in AEC plants also carry, however, these detectors tell only of radiation already received.



An even newer type of detection instrument is a capsule worn on the lapel—

ELECTROSCOPE

If a super-thin piece of gold leaf or metal-coated quartz fiber is attached to one of the electrodes in the ionization chamber, it gives a visual indication of the electrical charge by bending away from the electrode. Thus, by putting a scale into the instrument, a self-reading "dosemeter" is obtained. The rate at which the fiber moves is a measure of the rate of radiation. This principle is used in another pocket detector like the fountain pen and in large instruments used to check wide areas where radioactivity is suspected.

PROPORTIONAL COUNTERS

If a battery is connected to the electrodes, the amount of current which flows through the circuit will show how fast the charge on the electrodes is being dissipated by radiation. This current is extremely small, but it can be boosted by vacuum tubes. A dial reading can be obtained which will show the rate of incoming radiation.

If certain gases are used instead of air, and high voltages are used, a single radiation produces more ionization. Pulses of current result, which can be easily measured. This is the principle of devices known as proportional counters, which are widely used for measuring contamination on hands or clothing, tables and other surfaces. They will be extremely valuable in checking residual radioactivity after an atomic bomb explosion, or in the event of radiological poisoning.

GEIGER-MULLER COUNTER

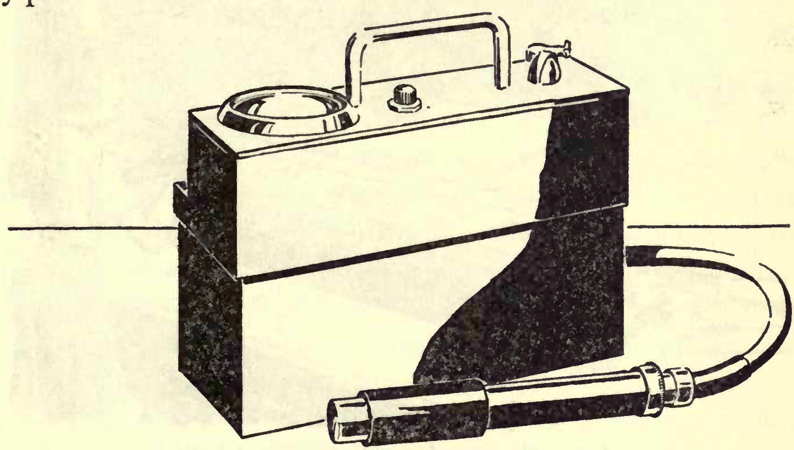
The familiar "click-click-click" of the Geiger counter is the warning rattle of the atom. Each click is a pulse of ionization caused by an individual particle or unit of radiation. Because this famed instrument can pick up even a single ray, and is easily portable, it is the instrument which will probably give the first signs that radiation is present in an atomic attack.

Actually, the Geiger counter is nothing more than a stepped-up ionization chamber. Its heart is a glass or metal tube with a wire running through it lengthwise. The tube contains gas at low pressure. High voltage is applied to establish a strong electrical field between the wire and the tube. The voltage is such that the gas is just about ready to "break down." This delicate electrical balance is broken by a ray penetrating the walls of the tube. The ray rips apart the atoms of the gas,

producing free electrons. The electrons rush to the central wire and a click, or pulse, results in the listener's earphones.

Geiger counters will be the unsleeping mechanical policemen of the atomic age. They can tell when any radioactive material is in the vicinity, and give a rough indication of the strength of its radiation. But they require large amounts of power. They do not differentiate, normally, between the various types of radiation. They count beta particles with much more efficiency than gamma rays, and alpha particles only if the counter is equipped with a very delicate "window."

The Geiger counter will be used by monitoring crews to track down radiation, but other instruments will be necessary to tell the exact hazards to health of radioactive poisons or by-products of the bomb.



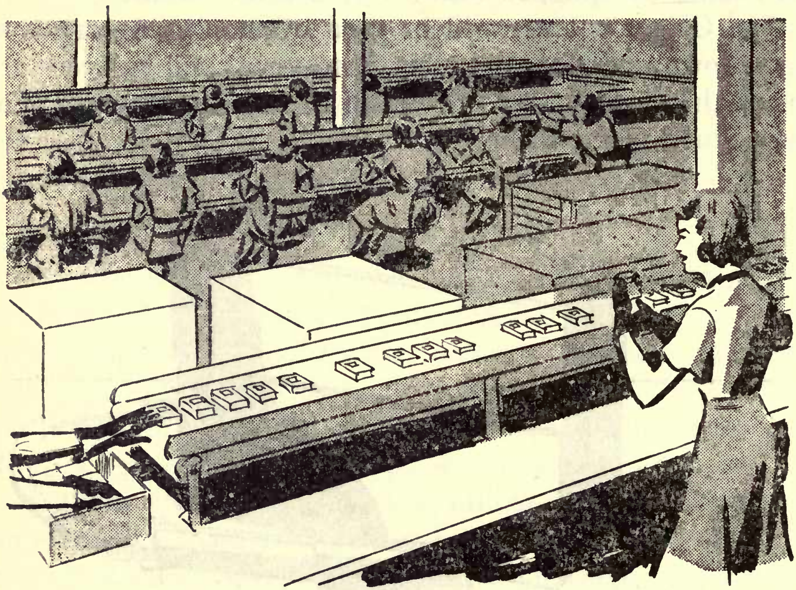
The Geiger counter is easily portable—

SCINTILLATION COUNTERS

When radiation strikes certain types of crystals, the structure of the crystals becomes electrically excited. The crystals

fluoresce — that is, they give off light. The amount of light released is very small, but it may be focussed on a light-sensitive electron tube and thus measured. This type of instrument, called a scintillation counter, has been used mainly in the laboratory to study radiation. But a portable counter is now being developed at Brookhaven National Laboratory which scientists think will be able to measure gamma rays in places where the radiation is so strong other instruments break down.

ATOMIC DETECTORS FOR YOU



A simple, sturdy radiation meter—

For any nation-wide program of defense against atomic weapons, tens or hundreds of thousands of detection instruments will be needed. They must be simple to operate, rugged and dependable. They must be inexpensive and widely distrib-

uted. Since the fall of 1949, Atomic Energy Commission scientists have been working at top speed to find instruments which meet these specifications.

At Oak Ridge, Tenn., AEC instrument specialists are working on a simple sturdy meter which is the size of a package of cigarettes. Based on the ionization chamber principle, it will measure the dose of radiation its owner is receiving at any time, and thus will offer ample warning if a particular area is "hot." A similar radiation meter has been invented by a father-and-son scientific team at California Institute of Technology, Drs. Charles C. Lauritsen and Thomas Lauritsen. Their device can be either cigarette-package size or small enough to be worn on the wrist like a watch. Unfortunately, neither of these devices are yet being made for general use.

Although only barest mention of its existence has been made, the Navy has a sort of "atomic dog-tag" to identify radiation victims. Like photographic film, this metal tag is treated chemically so that it will react to radiation. When a fatal dose has been received, the dog-tag shows it by turning blue. It will be of little help to a potential victim during the time radiation is at work. But for doctors working in an atomic disaster area it would be a valuable guide. They wouldn't waste time in trying to save those whose dog-tags were bright blue, but would concentrate on those whose tags were near-white or only pale blue.

Of potential use to the man-in-the-street is another form of chemical radiation indicator now under development at the University of California at Los Angeles. This consists of a series of tiny vials containing liquids whose colors change when radiation hits. Each of the vials or capsules changes color at a different dosage level. They may be worn hung from

the neck in a plastic case the size of a packet of paper matches, or carried in the pocket in a pencil-like container. A glance would tell an individual if he receives radiation, and how much.

A chemical detector no bigger than a book of matches—

As is only too apparent to the officials planning atomic defense, these instruments and detectors for the home and the private citizen are all still "under development," or "being studied" or "recently invented." The atomic alarm, if such must ever be sounded, must be given by trained radiation monitors using the best equipment at hand: the Geiger counter, the proportional counter, the ionization chamber and photographic films.

Theirs will be a large part of the job of averting panic, for only by quick and accurate information on the extent of radio-

activity in an attacked area will a general stampede of the uninjured to parts elsewhere be averted. Decontamination crews will be guided by "Geiger men" when the clean-up begins. Doctors will rely on their instruments in deciding whether or not a leg must be amputated because of invisible contamination in a cut on the toe. The food you eat may be "cleared" by a radiation monitor; certainly the city water you drink will be carefully checked.

These were the conditions automatically imposed on the world the day the first atomic pile began operating in a University of Chicago squash court. For with the harnessing of atomic energy came an entirely new form of possible injury to the human body—injury which you cannot see or feel, injury which comes from invisible sources, injury which will kill you if enough is received—kill you just as dead as a steel-jacketed bullet.

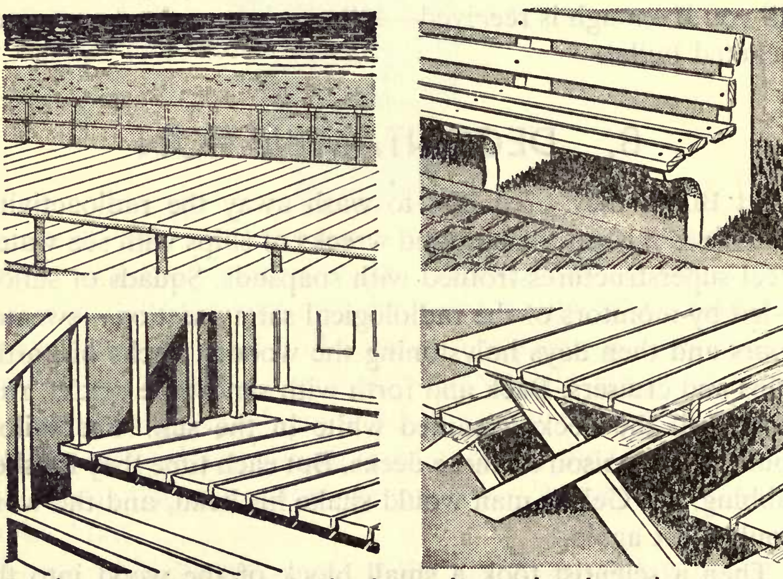
8. DECONTAMINATION

At Bikini they tried first to wash away the radioactivity. Fire hoses flushed the battered wrecks of ships with sea water. Steel superstructures frothed with soapsuds. Squads of sailors—led by monitors of the radiological safety section—sweated hours and then days holystoning the wooden decks of battleships and cruisers. Back and forth with sandstone bricks, rubbing until the decks gleamed white in the sun. The sailors could see no poison on those decks. But each time they finished rubbing, the Geiger man would shake his head, and the work would start again.

Then a scientist took a small block of the wood into the laboratory. He found that nearly a quarter of an inch had to

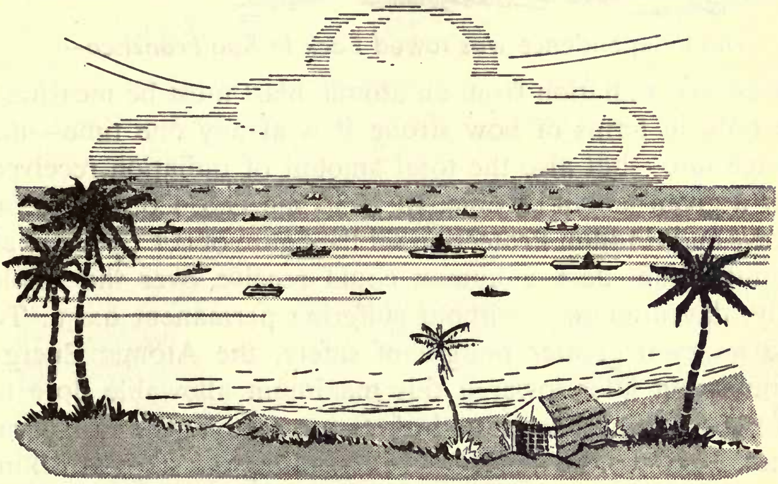
be shaved away with a plane—the entire top surface of the deck skinned off—before the Geiger counters would be quiet.

Weeks after the "Baker" test, the underwater blast, a sailor was working on a rusting, twisted landing craft on the atoll beach. One hand slipped while he was hauling at a steel cable, and a small cut appeared between thumb and forefinger. Taken to sick bay on the radiological ship, the white-faced seaman waited while delicate tests were made on the open tissues of the wound. If contamination by the invisible poison of atomic fission were found, his arm would have to come off at the shoulder. High amputation was a hard-and-fast rule in the Manhattan District project for such cases. This cut was little more than a scratch—but the cable had been checked and found to be still radioactive.



Nearly a quarter of an inch of wood must be shaved away to remove contamination—

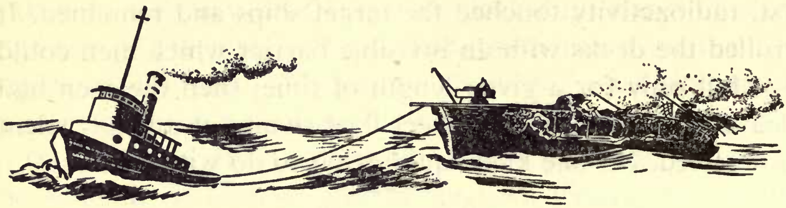
The cut was free of contamination, luckily. The sailor went his way with merely a small bandage on his hand. But the incident went down in the terrifying record written by Atomic Bomb No. 5—the first to be exploded under water, not high in the air, and the first to leave man faced squarely with the silent specter of radiological poisoning. In the underwater burst, radioactivity touched the target ships and remained. It patrolled the decks with an invisible barrier which men could cross, but only for a given length of time; then the men had to leave. The ships of the target fleet swung at anchor, silent and deserted. No one knew quite what to do with them.



The ships of the target fleet swung at anchor, silent and deserted—

Radiation dosage is measured in terms of the roentgen or "r" named for Wilhelm Roentgen, the German physicist who discovered X-rays in 1895. It is usually accepted that a dose of 400 r of radiation received over the entire body in a few minutes is a "median lethal dose"—that is, it would be fatal to about 50 percent of human beings who received it. In radio-

activity left behind after an atomic bomb explosion, however, or deposited in radiological attack, the problem of radiation is quite different from a "one-shot" dose. While a human being would have only a 50-50 chance of survival if he received 400 r of radiation all at once, the same amount of radiation spread over a period of a month would be far less dangerous.



The Independence *was towed back to San Francisco—*

Residual radiation from an atomic blast must be measured not only in terms of how strong it is at any one time—the dosage rate—but also the total amount of radiation received over a given length of time. In 1936 the U.S. Committee on X-rays and Radium Protection set the figure of 0.1 r per day as the maximum dose a human could receive over the whole body, day after day, without suffering permanent harm. To give an even greater margin of safety, the Atomic Energy Commission later lowered this maximum allowable dose to 0.3 r per week for workers in U.S. atomic plants and laboratories. This was the figure used in handling the ships at Bikini after the Crossroads tests.

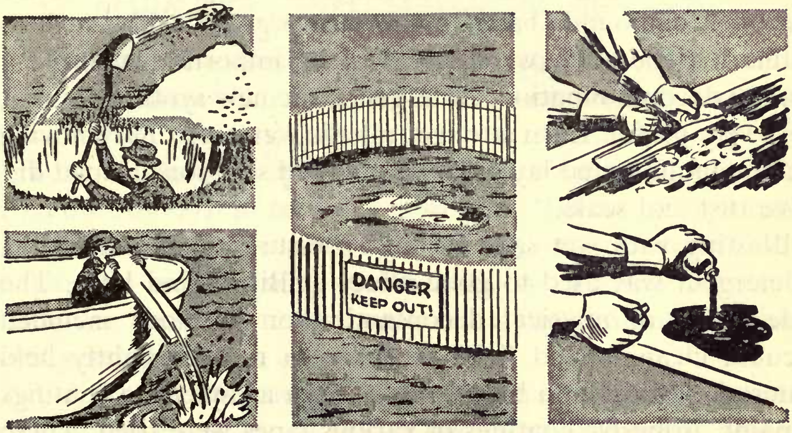
The *U.S.S. Independence,* a small aircraft carrier, received such a large dose of radiation from the "Baker" blast that it would have killed any crew members who might have been on the hangar deck. Two weeks after the blast the radioactivity of the ship had dropped to about 3 r per day. That meant decontamination squads could go aboard for short periods of

time—perhaps 20 minutes a day for any one man. A long year later, the *Independence* having meantime been towed back to San Francisco, the average dosage rate was down to 0.3 r per day—still seven times the limit for full-time occupancy.

No decontamination was attempted on the Independence. The carrier was too battered ever to be used as a fighting ship again. But on other ships new knowledge of decontamination began to be accumulated, through the long, arduous process of trial and error. Some of the ships were decontaminated and put back into use, while the Independence lay at her moorings in San Francisco, still "hot" with radiation.

METHODS OF DECONTAMINATION

There are three courses open when an object is radioactive, whether it be a ship, a building or a heap of waste from a nuclear reactor: 1. bury it deep in the ground or jettison it at sea; 2. isolate it until the radiation level drops below the danger limit; or 3. decontaminate it.



1. BURY IT DEEP OR JETTISON IT   2. ISOLATE IT   3. DECONTAMINATE IT

Three courses are open when an object is radioactive—

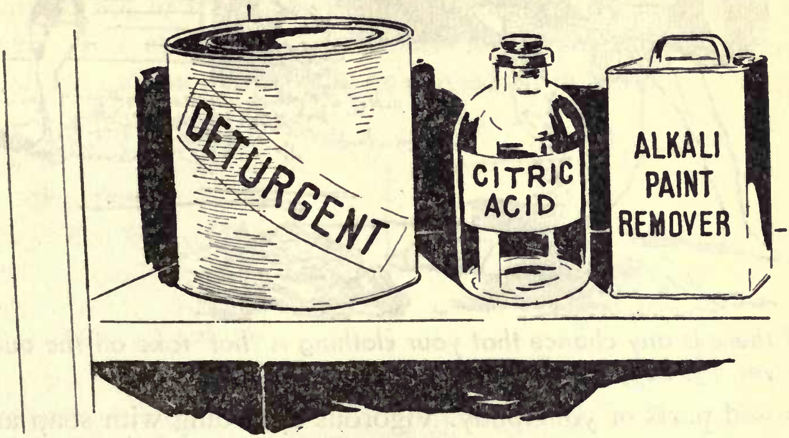
Decontamination means, to a large degree, stripping away the radioactive surface, cleaning it either by chemical means or physical means. There are exceptions to this, of course: When a radioactive solution has soaked into a porous surface such as rope, cloth, unpainted wood, brick or stucco; when neutrons have set up radioactivity deep within the object; or when a reservoir of drinking water is contaminated.

If chemicals are to be used to clean a "hot" surface, the nature of the radioactive materials must be known. When uranium 235 fissions, as in an atomic bomb, nearly 200 radioactive products, isotopes of some 34 different elements, may be present. The chemistry of identifying these poisons is an intricate business. It is further complicated by the fact that a chemical reaction will not eliminate the radiation. It will merely turn the contaminating agent into a new form which can be flushed away. Something has to be done with the drain-water, after that.

But much was learned at Bikini about chemical decontamination. Compounds based on certain organic acids, such as ordinary citric acid, were found to be important agents for general decontamination. Detergents, the new synthetic soaps, were very useful. Even stronger alkalis were used in removing entire contaminated layers of paint. Acid solutions helped dissolve rust and scale.

Blasting with wet sand or high-pressure steam containing a detergent was used to good effect at Bikini and later. The wide range of physical decontamination methods included vacuum cleaning and light brushing to remove lightly held material, and use of a blowtorch to burn away entire coatings of paint. Adhesive coatings of various types were tried. These could be stripped away carrying radioactive materials with

them. Special plastic paints which could be easily removed in case of contamination have even been considered by scientists as a means of minimizing the residual radioactivity after an atomic poisoning.



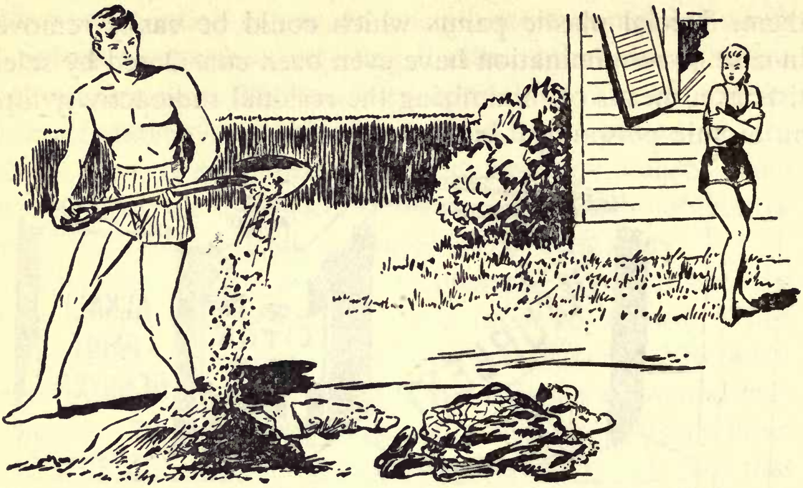
Acids, detergents, and alkalis will remove contamination—

REDUCING CONTAMINATION AT HOME

There are a number of things you can and should do in your own home after an atomic bombing, to reduce danger of radioactive contamination.

Your clothing will normally prevent radioactive residue from the bomb from reaching your skin. If there is any chance that your clothing is "hot," take off the outer layer and bury it. Do this before going into a building, such as your own home, for there may be no contamination inside the house—until you unwittingly carry it indoors.

Radioactive substances which come in contact with the skin may be more dangerous than a detecting instrument held an inch away would show. You should carefully cleanse any ex-

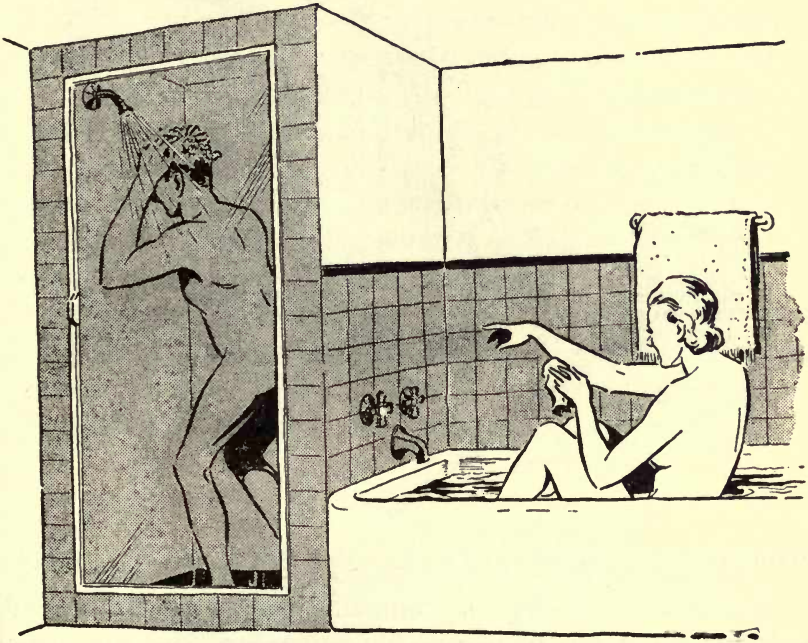


If there is any chance that your clothing is "hot" take off the outer layer and bury it—

posed parts of your body. Vigorous scrubbing with soap and water will accomplish a remarkable amount of decontamination. Pay particular attention to the hair, nails, skin folds and areas surrounding body openings. Be careful not to rub so hard that you break the skin, however. If soap and water does not remove the radioactivity, as shown on an instrument, a dilute solution of sodium bicarbonate may be used. This is particularly useful for rinsing mucous membranes, such as the mouth and nasal passages.

In a dire emergency, any clean uncontaminated material at hand, such as grass, paper, straw, leaves or sand, will remove radioactivity from the skin if rubbed on vigorously. These might be used, for example, if you were covered with water or soil thrown into the air by an atomic explosion. Again, do not tear the skin or force loosened material into wounds, body openings or skin folds.

For cleaning household objects, almost any method would be helpful. Cleaning and scouring compounds, grease removers, detergents, paint cleaners, dry cleaning liquids, gasoline, etc., will help to remove radioactive particles from surfaces. Be careful not to spread or rub in the radioactive materials, however. The cloths you use should be buried rather than burned, for radioactivity would be carried off in smoke.

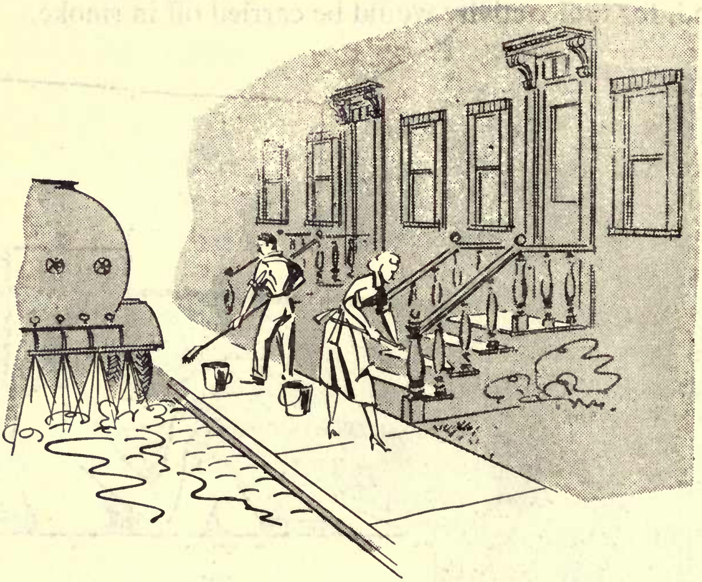


Vigorous scrubbing with soap and water will accomplish a remarkable amount of decontamination—

DECONTAMINATION OF LARGE AREAS

While you are doing these things, the decontamination of vital areas of your city would begin. Crews would flush the streets with water, perhaps with the aid of detergents. Brush-

ing or vacuum sweeping of outdoor areas might even be tried first, if feasible. Remember that there is no known way to neutralize radioactivity. Decontamination only transfers it from one place to another. Proper disposal of the "hot" material must be provided, carrying or flushing it to a place where it will not constitute a hazard.



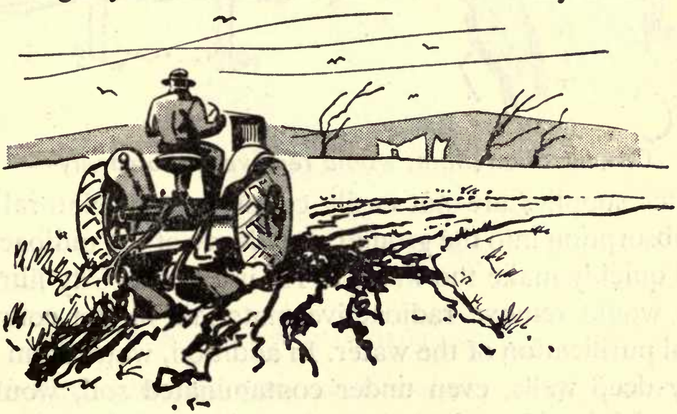
Scrubbing the sidewalks and flushing the streets would be helpful—

One of the first steps in complete decontamination would be removal of the industrial film of grease and dirt which usually covers exposed surfaces, especially in cities. Radioactivity seems to attach itself strongly to such a film. Ordinary soap and water, detergents or live steam are among possible ways the film may be removed. In this initial work, decontamination crews would seem like men from Mars. They would have to wear protective clothing, such as rubber suits, boots

and gloves. If spray or dust is involved, goggles and respiration masks must be worn. Sandblasting and strong chemicals would be used to remove the entire top surface from the outsides of important buildings. Other structures, where decontamination might be too costly, or the radioactivity too high, would have to be dismantled, carried away and buried.

In soil, the radioactivity would be held in the uppermost few inches. The top surface of parks and lawns in a contaminated city would thus have to be either removed or covered with at least a foot of fresh earth. This could perhaps be done by turning the soil over, so that lower uncontaminated layers covered the part that was "hot." Deep plowing of exposed lawns and vacant lots would begin, after the areas had been thoroughly wetted down to prevent radioactive dust from escaping into the air.

Badly contanimated clothing, rugs, curtains and upholstered furniture would have to be buried or burned in incinerators especially designed to prevent the escape of radioactive smoke. Lightly contaminated articles can be dry cleaned.



Deep plowing of exposed lawns and vacant lots would begin—

CONTAMINATION OF FOOD AND WATER

Gamma rays have no harmful effects upon food. Properly covered food should undergo little or no contamination, unless it has been within very close range of an atomic burst, where neutrons would make everything radioactive. Unless this is the case, canned goods and foodstuffs in airtight, dust-proof wrappings should be safe. But unprotected food, whether it be in the home, the store or still growing in fields, will have to be destroyed if once contaminated. There is no known way to salvage it.

City filtration plants would remove radioactivity—

Water supplies are not easily contaminated. Natural dilution, absorption into the ground, and decay of the radioactivity would quickly make the water fit for use again. City filtration plants would remove radioactive materials in the course of normal purification of the water. In addition, water from moderately deep wells, even under contaminated soil, would be safe to drink unless there is surface drainage into the well.

Water may be distilled and made perfectly safe. But it should be emphasized that boiling of contaminated water would do no good at all. Boiling is useless against radioactivity.

The most effective means of decontamination is to let the radioactivity die away by itself. This decay is rapid at first, slowing only when the more dangerous—the really "hot" materials—have spent their energy. In any future atomic bomb attack, the hazards of contamination will be secondary to the chaos wrought by blast and heat. And radioactivity, like measles or mumps, is a community danger which can be met and handled safely.

9. PREVENTING PANIC

Fear of war may hasten its coming—

One of the greatest dangers of the atom bomb is the panic it can produce. In addition to what we know about the destruc-

tive force of this weapon, there is the additional terror of the unknown to scare us.

If you let it, the atom bomb can disrupt your life with jitters whether or not any bomb ever actually falls. And yet there is no real need for this. Individually, we all must face the prospect of death sooner or later. And for many it will come quickly and without warning. Yet this need not keep us from a satisfying life.

The strain of anticipated peril is often even more unbearable than the presence of the danger itself. Suspense and the expectation of enemy surprise is terribly unnerving. People often even prefer war to such a life of tension and insecurity.

Thus it is that the fear of war and the awful consequences of war may plunge us headlong into war's reality. People may be eager for the blitzkrieg to start—just so that action can bring relief from the nerve-wracking tension of the sitzkrieg.

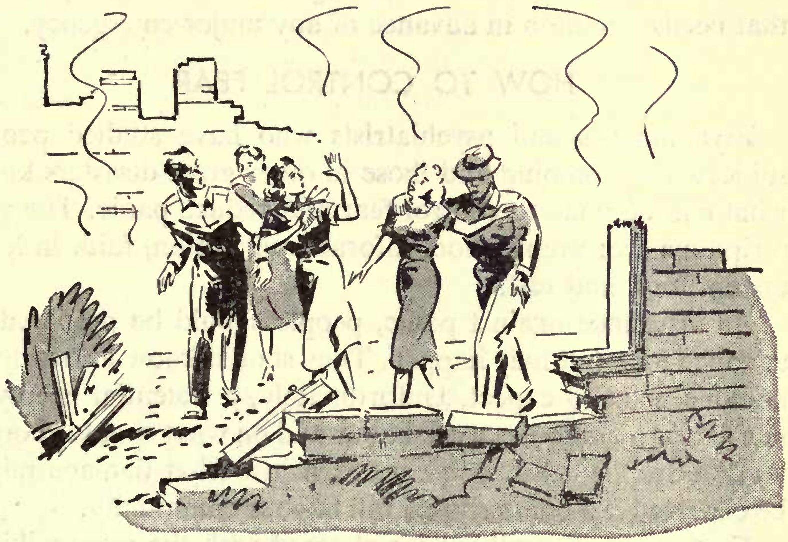
Psychiatrists looking into the state of America's mental health see signs of jitters and panic-ripeness in our tendency to see "flying saucers" in every cloudless sky and to fear "reds" behind every desk and in every position of responsibility.

If and when an atom bomb ever does fall near you, you will be scared. There is no doubt about that. If you are normal, you will be plenty scared.

You may not be aware of your own emotion. In fact the chances are that you will be numbed, stunned. You will probably go about like a sleep walker, going through motions in an automatic, robot way. This is the reaction of three-fourths of all the persons involved in a major disaster—whether it is a bombing, a catastrophic fire or a devastating earthquake.

The expressions, "scared stiff," "paralyzed with fright," "frozen with fear," describe very well the effects on 75 percent

of us. Such persons, caught in an emergency, may be unable to get out of bed and dress themselves. Even if they are physically unharmed, they are unable to take any action to save themselves or others, but lie down to await the death that appears inevitable. Some pass from this paralyzed state into death without ever coming out of their death-like trance.



One person out of five remains cool and collected in the face of major disaster—

We know what happened when the first atom bombs dropped on Hiroshima and Nagasaki. Some people dashed along the roads without any destination in mind, in a purposeless stampede, screaming out their terror. Others remained apathetic, apparently unable to sense what had happened to them and what they needed, and equally unable to do anything about the situation.—What would you do?

About one person out of five, it has been found, remains cool and collected in the face of major disaster. These are the persons who are the only ones capable of realizing the situation. They can formulate some appropriate plan of action and can see it through. It is on them that we must depend.

How to give air to this 20 percent who have cool heads, to add to their numbers, and to strengthen them, is the problem that needs attention in advance of any major emergency.

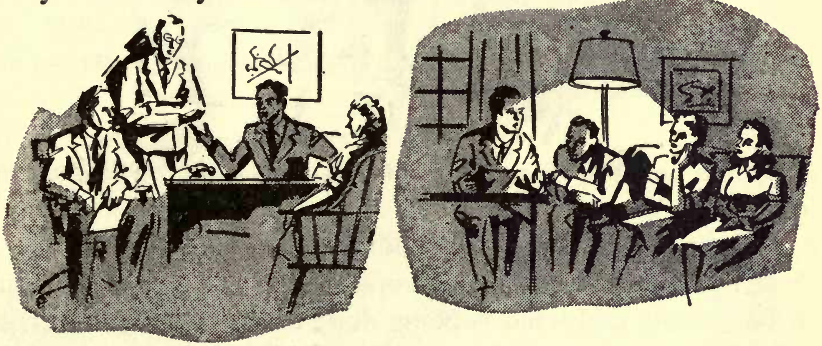
HOW TO CONTROL FEAR

Psychologists and psychiatrists who have studied people subjected to bombing and those in other great disasters know what can be done to control fear and reduce panic. The prescriptions are: preparation, information, action, faith in leadership, food and rest.

As insurance against panic, people should be prepared in advance for what may happen. They should know as nearly as possible what to expect. Unfortunately, a potential enemy is not likely to notify us at what hour and on what spot his bombs will be dropped. But you can learn just what damage might be expected if a bomb should fall in your community.

Formation of small groups charged with the responsibility of taking action in your own particular neighborhood in case of emergency is useful psychological protection. You will have less tendency toward panic if you feel that you have the backing of the solidarity of a group, especially if the group is headed by a leader you know well and in whom you can put your trust. You may want to belong to more than one group—say one in your office and one in your home. Then, wherever you may be when the blow strikes, you can feel that someone is looking after things at the other end.

It is better to pass information on to the public about what damage to expect from a bomb if this warning is given to them personally in groups, psychiatrists suggest. Dr. Dale C. Cameron, assistant director of the National Institute of Mental Health, warns of the disturbing effect of such information transmitted by radio, television, films or newspapers. It is natural, he points out, for you to feel anxiety when you start thinking about such hazards. You can not voice your anxiety to radio or to television or movie screen. But if your informant is present in person you can ask questions and dissipate some of your worry by expressing it. If you are in a group you can also feel that you and your neighbors have the same uneasiness and stand ready to help each other out; that it is not necessary for you to face your fears alone.



You may want to belong to a group in your office and one in your home—

Information about possible damage to be expected should, if possible, be accompanied by information about plans to meet specific emergencies. What can be done if water mains are destroyed? Where are wells and other emergency sources of water? Suppose the electricity is cut off. How can you manage for lights? What if telephone lines are down and

radio stations destroyed? Who is prepared to keep up communication?

KEEPING THE PUBLIC INFORMED

Keep the newspapers coming out; keep the radio stations on the air—

Next to being prepared in advance for possible dangers, it is of utmost importance for people to be informed about what is happening and what is being done about it. In the absence of reliable news, rumors run like wildfire. And rumor is the father of panic. Rumors grow in the telling. Rumors nearly always make things seem worse than they are—don't believe them.

In time of atomic disaster, the people will turn to the sources of news that they have learned to rely upon. These news sources should continue to function no matter what befalls a city or an area.

Keep the newspapers coming out. Keep the radio stations on the air, even if it means using some two-way police radios for news dissemination, or bringing in some walkie-talkies.

People will want an official truthful account of what is happening to them. They will also want to know what is going on in other places, whether theirs is the only city under attack, how others have fared.

Study of men in combat has told psychologists something of how to control fear and avert panic. Action, it was found, dispels fear. If an atom bomb drops, do something. Prepare yourself in advance so that you will know what you can do and how to do it, whether it is first aid, clearing debris from the streets so that rescue apparatus can get through, or setting up emergency light or water sources. Learn how well enough so that at least some of the work can be done almost automatically even if you are distracted by fear, noise and confusion.

Get acquainted with your neighbors—

When and if a bomb drops, go into action. Start work immediately. Delay and waiting for orders or direction build up fears, action works them off.

PREPARATION FOR A CRISIS

Before any bomb drops, prepare yourself by building up your mental health. Get plenty of food and rest. Don't let a bomb catch you on the verge of jitters from too much drinking or smoking or from late nights and overwork. If you are a lonely person, make a deliberate attempt to make friends. Get acquainted with your neighbors. The time may come when you will need them and they will need you.

Practice love and affection in your family circle and among your associates. In time of emergency, we are often steadied and carried through by the comforting assurance that we are loved. Nothing is so terrifying in time of disaster as the feeling that no one cares, that we are alone with our terrors.

Hate and dislike lead to suspicion and suspicion to fear and panic. Love or liking, on the other hand, build up mental health and fortify us against terrifying situations.

This attitude could very well be spread from our immediate circle of family and close friends to neighbors, other cities, and even the world at large.

The real preventive of atomic panic is the building of a world where suspicions and fears are not rampant—where there will be no desire or temptation on the part of any enemy to drop an atomic bomb because there is no enemy.

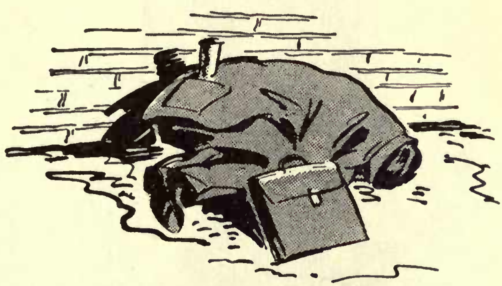
It is difficult to be friendly to someone who does not show any disposition to make friends. We want people to meet us halfway. But in some cases where fear and suspicion are already aroused, it is necessary to walk all the way down the

street and knock on a neighbor's door. Where people have different ways of thought, different cultural traditions, opposing points of view, it is necessary to make a real study of them in an effort to understand them and be able to make them understand us.

Shoulder to shoulder work in a concerted attack on common enemies such as poverty, ignorance, hunger and disease is a good way to build up understanding and confidence and reduce fear and the mutual suspicion which leads to cold war and atomic races.

10. PROTECTION IS POSSIBLE

When the sky pales and the blinding light of a hundred suns is everywhere, you will have less than a second to protect yourself—approximately the time it takes to say "Atomic Bomb" out loud.



Curl up in a ball as you hit the ground—

Instinct will tell you to look. Conquering that instinct may mean the differences between life and death. If you turn to see the bomb, radiation may blind you permanently. The heat flash will catch you full in the face, burning horribly if you are within two miles of ground zero. Don't look. Drop.

Curl up in a ball as you hit the ground. Put your hands (and arms, if they are bare) against your stomach, and duck your face into your chest. If you can shade all exposed areas of your skin, you are far less liable to be burned.

Stay in a ball for ten seconds. Both the heat and the blast wave will pass over you in that time. Then, if you can, stand up. You will be among the survivors—provided you can move fast enough to avoid falling rubble and fire.

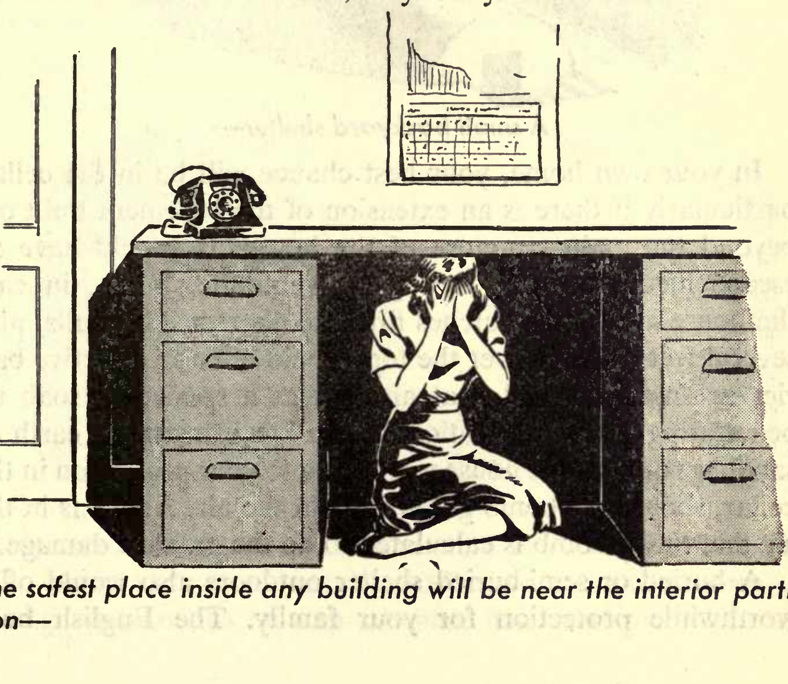
If the explosion catches you one step from a tree-trunk or doorway, you can take that step and crouch with your back

In this position debris and broken glass will fall out beyond you—

to the light. But if a possible shelter is two or three or four steps away, don't try to make it. You won't have time.

After the crucial ten seconds, the fronts of brick buildings may be crashing into the street. Your safest move will be to press yourself tightly against the nearest wall—preferably the wall of a concrete building, for concrete will not strip away like brick. In this position, also, cornices and broken glass from above will fall out beyond you.

Should the giant flash come when you are indoors, dive for the floor with your back to the window and crawl beneath or behind the nearest table, desk or counter. Anything between you and the window will stop not only the heat rays but also the jagged bullets of broken glass. The blast will be followed by wind of hurricane force; stay away from all windows for

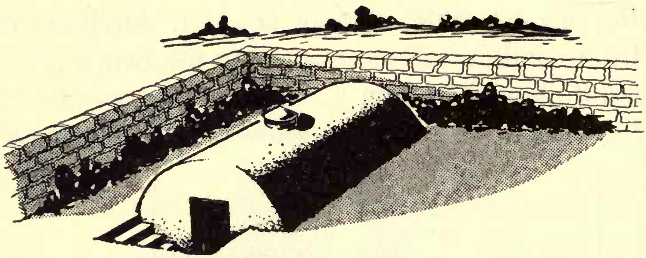


The safest place inside any building will be near the interior partition—

at least a minute. The safest place inside any building will be near the interior partitions. Keep as close to these as possible.

An unexpected atom bomb is a terrible possibility. There may be warnings of impending attack or even of approaching bombers, however. You may have time to reach shelter. There is such a thing against the atom bomb. Atomic shelters will be a vital part of civilian defense. Properly built, they would save thousands of lives.

SIMPLE SHELTERS



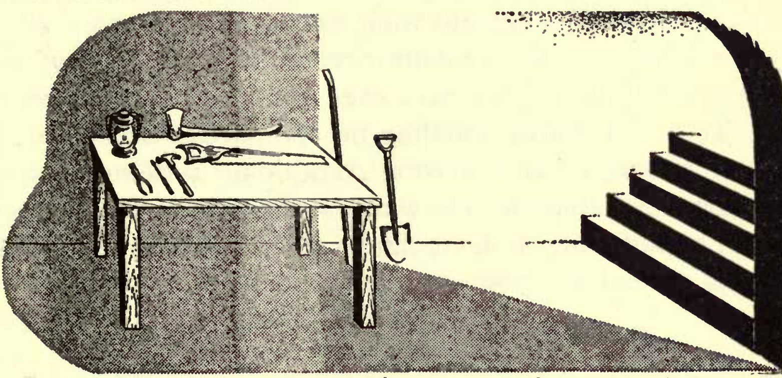
A small backyard shelter—

In your own home, your best chance will be in the cellar, particularly if there is an extension of the basement built out beyond the main structure of the house. It should have an escape hatch, perhaps through a ventilation shaft, in case the house above you catches fire or collapses. The walls, plus several feet of earth over the top, would offer an effective barrier against blast and heat and act as a sponge to soak up penetrating gamma radiation. A shallow rampart of earth or sandbags outside the house would add to your protection in the cellar, should the bomb go off high in the air. And it is in the air that the A-bomb is calculated to do the greatest damage.

A buried or semi-buried shelter outdoors also would offer worthwhile protection for your family. The English built

these by the thousands during the Battle of Britain. World War II brought them to many parts of Europe. Danger of tornados has already brought similar storm cellars to many parts of the American mid-West.

Ideally, your shelter should be completely underground, braced by foot-thick reinforced concrete walls and ceiling, with forced-draft ventilation piped through special filters which can eliminate radioactive dust or water droplets. But simple semi-buried earth-and-pole shelters, caves or tunnels dug into hillsides can give protection against blast, heat and radiation very close to ground zero. Outdoor blast bomb shelters of the type used in World War II, if covered with at least 20 inches of packed soil, would reduce nuclear radiation below the death level at distances greater than 3,000 feet from the explosion. The same effect would be achieved by roughly 12 inches of concrete, four inches of iron or about two inches of solid lead.



Emergency equipment stored permanently in the shelter—

Japanese survived in shelters as close as 900 feet to ground zero. Doors are not needed, if a baffle or turn in the entrance passage is provided to stop the heat flash and much of the

radiation. It is essential to have at least two ways of getting out of the shelter. Emergency equipment, such as a shovel, lantern, crowbar, hammer, saw, axe, screwdriver and pliers, should be greased and stored permanently in the shelter for the possibility that all exits are blocked by after the blast.

Plans for an 8 to 10 foot concrete tornado cellar are available at fifteen cents each from the Extension Agricultural Engineer, Oklahoma A. & M. College, Stillwater, Oklahoma. This shelter has been recommended by the American Red Cross for home construction in the mid-Western tornado belt. The National Security Resources Board, responsible for atomic defense planning, believes the shelter is one of the best for family protection against atomic attack.

For shelters near the place you work, the Atomic Energy Commission and Department of Defense recommend the lower floors of fireproof, reinforced-concrete or steel frame buildings. These buildings will offer greatest resistance to collapse. A 12-inch reinforced-concrete wall, well tied into such a structure, would provide adequate protection against blast and nuclear radiation at distances over half a mile from ground zero. To guard against inhaling the radioactive dust of a surface or underground explosion, ventilating systems must be shut down and all doors and windows closed in an emergency. But air conditioning systems can be left in operation, provided there is no leakage from outside.

THE CENTRAL CONTROL STATION

It will be in such a shelter as this that your city's central disaster station will be located. Here the vital orders for firefighting and rescue operations will be prepared and sent out. Teams of doctors and nurses, radiation monitoring crews,

decontamination squads and the heavy equipment for clearing rubble must have a headquarters to ensure coordinated effort.

One of the most ticklish questions your city must decide is where to put these control centers, and how strongly they should be built. First, no one knows where ground zero will be. Second, the gigantic force of the atom bomb, even of the "obsolete" types we used on Japan, makes it impractical to design a building which would stand up under an atomic explosion directly overhead. What is the distance, then, at which protection becomes practical? How far away will construction engineers assume the atomic bomb goes off in building shelters and strengthening buildings?

Any decision here is a calculated risk. But from science's knowledge of the destructive effects of the bomb, through blast, heat and nuclear radiation, present planning is based upon a distance of half a mile from ground zero. Inside that circle, destruction and death will be virtually complete. In atomic attack, this mile-wide area must be written off as doomed. Your chances of surviving there, to put it mildly, range from poor to nil.

But beyond 3,000 feet, slightly more than half a mile, the ratio of deaths to survivors begins to fall off rapidly. Protection becomes practical. Buildings can be strengthened enough to withstand the blow. In fact, at Nagasaki, there were no earthquake-resistant, reinforced-concrete buildings which suffered serious damage to their frames at distances greater than 2,000 feet from ground zero.

Contrary to popular belief, U.S. buildings are not much stronger than those at Hiroshima and Nagasaki. Many are weaker, for after the disaster of 1923 the Japanese wrote earthquake protection into their building codes. Only in the

eleven Western states are similar earthquake-proof buildings required in the United States.

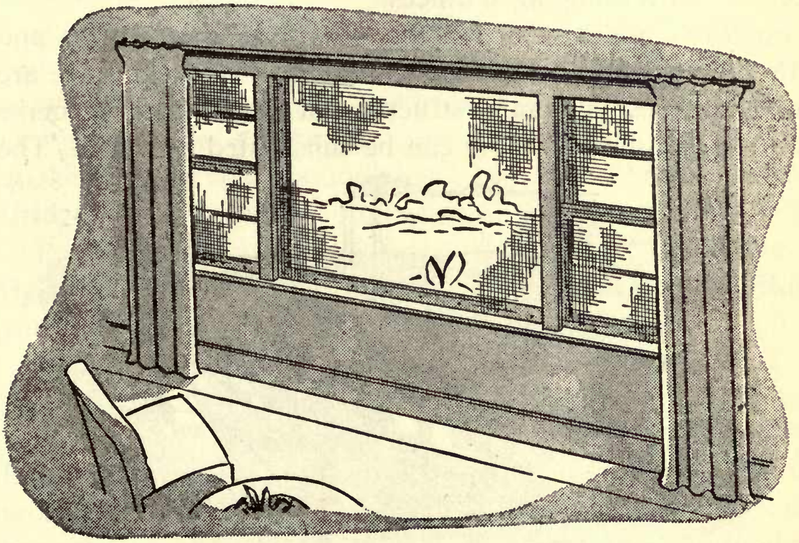
American skyscrapers, much higher than any buildings in the Japanese bombings, are built on heavy steel frames. Buildings such as these, which include office buildings and many hospitals, would withstand the blast of an atomic bomb quite well. But brick buildings, small or large, almost surely would crack and crumble up to a mile from ground zero, and suffer severe damage if within a mile and a half. Individual homes, whether of brick or wood, would not fare much better than Japan's "paper homes." Within 7,500 feet, nearly all would suffer severe structural damage.

Remove heavy indoor lighting fixtures which might fall—

HOW TO MAKE YOUR HOME SAFER

There are a number of things you can do to make your own home safer. Few will go to the extreme of building a two-foot-thick, reinforced-concrete wall around the house, although this would provide almost complete protection. But you can remove overhanging cornices, heavy indoor light fixtures which might fall, false ceilings and the like. Light, combustile curtains and draperies are a serious fire hazard at your windows. Such ornamental fabrics should be fireproof—or removed completely.

If your home is within three miles of a possible A-bomb target and you have a picture window in the living room, you might substitute plastic for plate glass. Wired glass would also make your windows safer. Half-inch wire screening stretched



Wire glass and half-inch wire screening will make your windows safer—

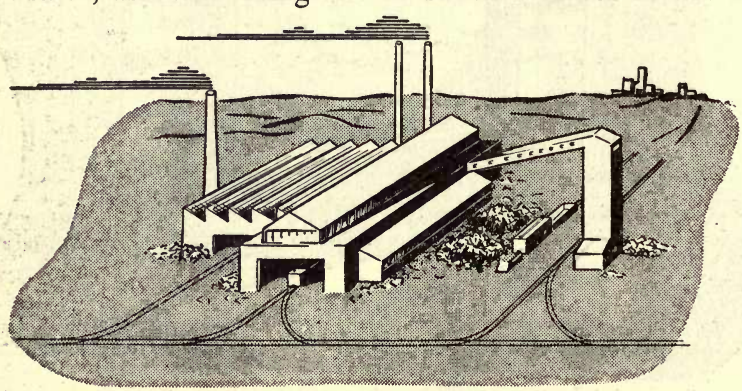
over the wired glass and nailed to the window frames would make them safer yet. But muslin or paper glued over the glass would do no good at all. The massive blast of the atomic bomb would blow in the window anyway.

If your home is within five miles of water, remember that brick, concrete, stucco and unfinished wood can absorb the radioactive rain and mist thrown out by an underwater explosion. A coat of paint makes decontamination much simpler.

If you cook or heat with gas, make certain there is a cut-off valve in the basement—and that you know how to use it.

Larger buildings in a possible target city can be strengthened by added bracing and shoring or new transverse reinforced-concrete walls. They can be made safer for the man in the street by stripping them of all outside ornamental brick or stone and overhanging cornices.

Factory buildings, with light, saw-tooth roof trusses and little more than a corrugated shell over a steel skeleton, are among the most vulnerable structures in atomic blast. To make them safer, asbestos siding can be substituted for metal. The



Factory buildings with light, saw-toothed roof trusses are among the most vulnerable structures—

corrugated asbestos breaks up readily and thereby lessens the shock on the framework of the plant. Blast walls of reinforced concrete twelve inches thick can be built to protect equipment such as generators, boilers and vital machine tools.

NEW BUILDINGS

In the construction of new buildings in a possible atomic target area, factory, office building or home, the Atomic Energy Commission makes a few common sense suggestions.

If possible build at least three miles from the most probable target.

If not, avoid extensive use of brick or other loose facings. These become deadly missiles when torn loose by blast.

Keep windows areas to a minimum. People who live in glass houses, shouldn't.

Instead of designing for a wind load of 15 pounds per square foot, as is generally the case in multi-storied buildings today, the building should be made strong enough to stand up to 90 pounds per square foot horizontal push. Details of earthquake-resistant construction should be used, wherever possible. Bridges can likewise be strengthened against sideways push.

If you build in a depression or ravine, it is better if it runs at right angles to the most likely explosion area. The hill behind your home will then shield it to a certain extent.

Build your buildings as resistant to fire as possible.

At Hiroshima and Nagasaki, fifty percent of the deaths and nearly three-quarters of the injuries were caused by burns. Burns from secondary sources — fires which followed the atomic explosions—were even more hazardous in many cases than the initial flash of pure heat. But something can be done to protect you from atomic heat and fire.

At Hiroshima and Nagasaki, falling rubble and flying glass caused more casualties than direct blast pressure. Something can be done to protect you against being crushed.

At Hiroshima and Nagasaki, not more than fifteen percent of the fatalities died from radiation sickness. And something can be done to protect you against radiation.

Living with the grim possibility of atomic attack does not mean laughing it off, nor forgetting about it, nor resigning to fatalism. "If it comes, we'll all be dead, so why worry about it" philosophy is just as unrealistic as not having a fire department in your town. Preparing for fire is a hard job. Preparing for the atom bomb is even harder, and it may seem far less necessary. Yet proper preparation can mean thousands of lives. Among them may be your own.

11. MEDICAL FIRST AID

For defense against an atomic war, the nation needs 20,000,000 lay persons trained in first aid. And those 20,000,000 will need special training in new things to do to save atom bomb victims. Some of these things will be so modified as to seem almost the reverse of what you do normally in giving first aid to a highway accident victim or an injured workman in your plant.

You remember from the Red Cross first aid course you took during the last war that the first thing you were taught was to keep an injured person lying down.

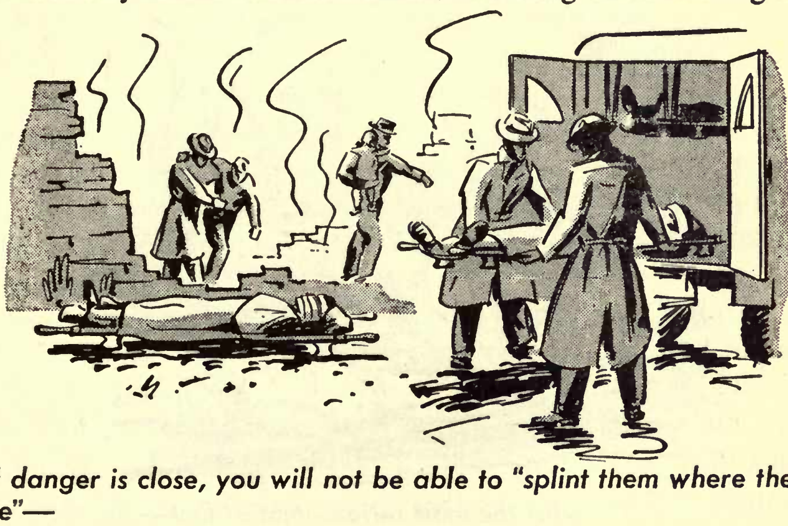
"DON'T let an injured person get up.

"DO keep an injured person lying down," read the instructions in the American Red Cross First Aid Textbook, with pictures to emphasize this important lesson.

But if you are going to give first aid to victims of an A or H bomb, you may not always be able to follow these time-honored directions. Your first job may be to get the injured person to safety, regardless of whether he is fainting or has broken bones. If fire is creeping close, if the walls or nearby buildings are about to fall, and if you are alone with half a dozen badly injured persons, you will not be able to "splint them where they lie."

In case of an atom bomb explosion it may be that the most life-saving thing you can do will be to rescue the injured from areas of hazard. It may be possible to give top-notch first aid care to many victims and this should be done wherever possible. But where there are many cases of badly injured and equipment is lacking, many of your carefully learned first aid lessons may need to be changed.

In the first aid course, for example, you learned to be careful about every minor cut and scratch, cleansing them thoroughly



If danger is close, you will not be able to "splint them where they lie"—

and perhaps applying a sterile dressing to guard against infection. In the event of an atom bomb attack, some of your patients may be covered with tiny cuts and scratches from flying glass. But in a critical situation you will pay no attention to these, and if that is all the injury the person has, you will send him on his way home or to shelter, telling him to see his doctor a few days later when things have quieted down.

You learned in the Red Cross first aid class to see what injuries the patient had and to care for the most serious ones first. You will be doing the same thing in case of an atom bomb attack, but on a much larger scale and with one important new feature added.

THE GEOGRAPHY OF FIRST AID

This new feature may well be included in the first lesson you will get in first aid courses revised and expanded to meet

Care for the most serious injuries first—

the needs of atomic war. This first lesson may be on the geography of an atom bomb attack as it relates to first aid to the injured. Through it you will learn to think of your home town in terms of circles or concentric rings, like the rings that spread out from the center when you drop a stone in a quiet pool of water.

At the center is the point where the bomb drops, if it is an air burst. What you do in the way of first aid depends on where you are in relation to this central point. Up to one mile out, in all directions, from this central point, will be the area of very heavy destruction from the blast damage and of deadly dosage of radiation. Most of the people in this area will be killed, but a few will survive. Authorities estimate that about 5% of people in this first zone will survive and not even suffer damage from radiation. The figures are based on the Japanese experience. Survival of these few people was due to the fact that they happened to be in places where they were sheltered both from blast and radiation.

For the next mile out in all directions there will be heavy blast damage and this is also the "dangerous dose" area of radiation. Here is where you will apply your modified first aid. This is the hazard area where there may be fire, falling walls and flying debris that could kill you and your patient while you are taking time to apply a splint or a tourniquet to stop bleeding.

Here also is the place where you probably will not have any splints or tourniquets or sterile dressings to apply even if you had the time. They will either have been destroyed or so covered with debris that you could not get at them. So you look first, as always, for signs of shock and bleeding, but also for signs of approaching fire or shaky walls. If the patient is

bleeding you put your hand right over the bleeding place, dirt and all, and press hard enough to check the bleeding. You keep up the pressure while you lead the man or woman to safety. More likely, you will have to show the patient where and how to use pressure and send him on his way alone, while you go on to care for the next victim, the next, and the next.

Keep up the pressure while you lead the patient to safety—

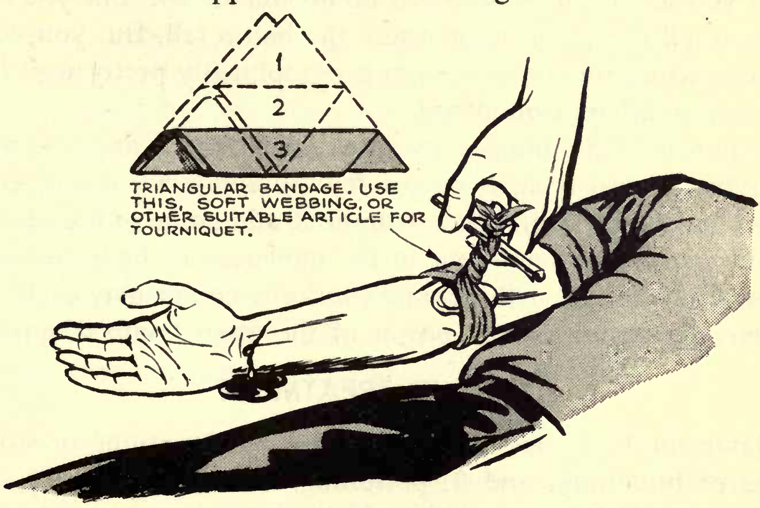
You may notice the symptoms of oncoming shock as you have been trained to do, but whether you have the patient lie down and try to keep him warm, to prevent shock, or whether you send him on to safer area or to his home will depend on the situation with regard to the likelihood of further damage and injury.

You do not need to worry or even think about the radiation effects. Up to the present, there is nothing in the way of first aid treatment that will overcome the effects of a heavy dose of radiation. All the things that can be done, including the

new methods now being tested in laboratories, for helping toward the possible recovery of patients who got heavy doses of radiation, will have to be done by doctors and nurses. Your role as a first aider will be to keep the surviving victims from bleeding to death or getting further fatal injuries before the doctors and nurses have a chance to try to treat them.

Remember this about the radiation from an atom bomb: It is all over in a minute or so. About 99% of the radiation produced comes out in the first fraction of a second after the bomb goes off. By the time you have picked yourself up, realized what has happended and pulled yourself together and begun to think about using your first aid training to help those around you, the danger is over. You will gain nothing by running away. You can safely stay and help those in need.

Next in the geography of atom bomb first aid are the areas between two and four miles out from the center where the bomb was dropped. Here the damage will be moderate to



Quick, proper treatment of leg or arm injuries—

slight. Most buildings will be standing; there will not be much fire danger, but there may be many casualties.

About 20 or 25% of the people in these two outer areas of a mile each will be killed. Many others will have severe injuries. There may be bad leg cuts that are bleeding profusely. Quick, proper treatment can save many lives here. And this is the area where top notch first aid can and should be given.

You will have time to do it because there will not be so many injured in your immediate vicinity, and you will have splints and other equipment to use. But even though you may see only two or three or five badly injured persons, the total number will be large because the area is circular. So the total number of trained first aiders must be large if people in this area are to be saved.

You will not, of course, stop to consult a map to see which area you are in after an atom bomb burst. Nor will you be able to tell the exact point where the bomb fell. But you will be able to locate yourself atom-geographically pretty well by the look of things around you.

If most of the buildings are down and you see fire, you are near the central area. If only a few buildings are down, and those mostly the small brick structures, and no large fire seems close, you are probably out in the moderate to light damage area. The one-, two-, three- and four-mile circles may each be larger, depending on the power of the atom bomb dropped.

FIRST AID TREATMENT

Look for 1. serious bleeding, 2. difficult breathing or stoppage of breathing, and 3. poisoning. Treat immediately, in that order, before you do anything else.

That is the Number One rule that will be taught the 20,000,000 persons throughout this nation who will be needed to give first aid in event of an atomic attack. It is the prime rule to remember at any time you are giving first aid, whether to victims of a highway accident or to someone who is accidentally injured at home or at your place of work.

Victims of an atomic attack will suffer many kinds of injuries. There will be all the kinds that would come in an ordinary bombing attack, plus a few peculiar to the atom bomb itself. Flash burns and burns from fire and injuries from blast, from flying debris and from collapsing buildings can be expected in varying degrees, both as to number and severity.

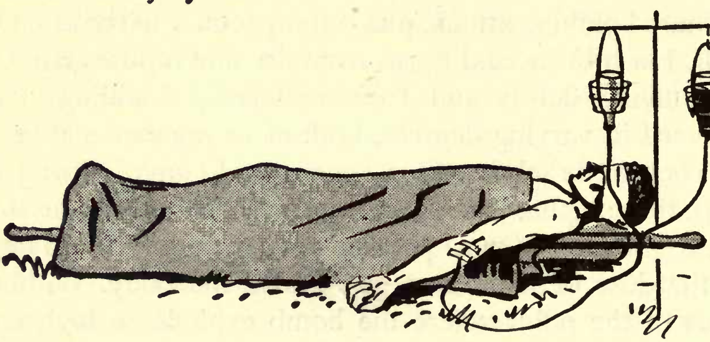
From the bomb itself, of course, will come ionizing radiations, those alpha, beta and gamma rays that are so mysterious and frightening to most people. The damage these do depends on the dose of them that gets inside the body. Within 500 yards of the point where the bomb explodes a high enough dose of ionizing radiation to kill is likely to strike most of the victims. But these same victims are also likely to be killed immediately by blast, fire and collapsing buildings. Even up to 1,000 yards out, ionizing radiation from the bomb will be great enough to kill, though the victims may not die immediately and may die of other injuries than that from the ionizing radiation.

In non-fatal cases of this radiation injury, signs and symptoms usually do not appear until two or three days after and sometimes not until three weeks after.

RADIATION SICKNESS

As a first aider, you will not be worrying about caring for these ionizing radiation injuries themselves. But if, two or

three days after the bomb burst, one of your friends or neighbors complains of feeling a little sick, and perhaps has been nauseated and had diarrhea, you might suspect radiation injury and advise him to see a doctor promptly. Many of the borderline cases may be saved by transfusions of whole blood. And perhaps by the time an atom bomb drops in your town, medical scientists will have found other good treatments for the radiation injury from it.



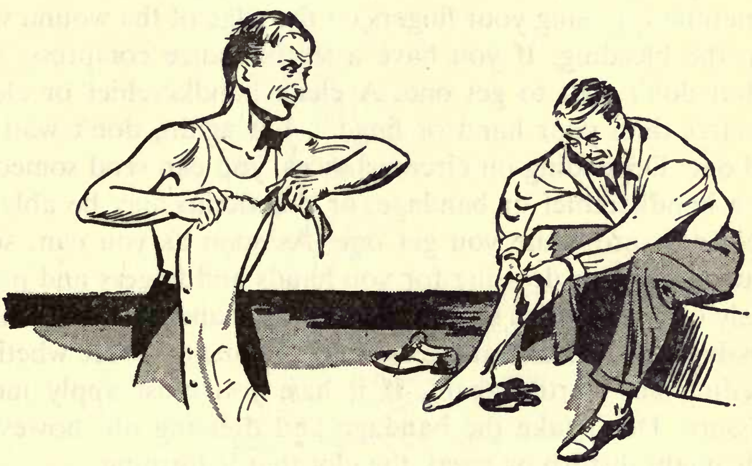
Many of the borderline cases might be saved by transfusions of whole blood—

Some of the victims may complain that they cannot see. Unless the eyes are protected, the flash of the bomb could produce temporary blindness. Normal eyesight will return in about five minutes, on the average, though this temporary blindness may last for several hours. You will help these victims to a safe place, reassuring them, and of course treating any serious injuries they may have. But leave the eyes alone. You don't want to put anything in or on the eyes that might cause infection. Radiation from the bomb can cause serious damage to the eyes. The number of these radiation cataracts so far reported among Japanese victims, however, has been small. They do not develop immediately and, like any other cataract,

require treatment by an eye specialist when they do develop.

As a first aider immediately after the bomb goes off, however, you are going to be busy helping people with bad burns, torn and mangled limbs, gaping belly wounds with intestines and other internal organs showing, and people choking and gasping for breath because of pressure on chest and belly or a wound that has pierced the chest. And there will be others with mouth and nose so covered by sand, gravel and other rubble that they cannot breathe.

SERIOUS BLEEDING



If blood is coming fast, it is serious, and you must try to stop it—

Remember you are going to look first for serious bleeding and stop it. Loss of more than two pints of blood at one time can be serious and may be fatal. If a large artery or vein is cut, blood will pour out fast and in large quantities. Bleeding is serious if bright red blood spurts from a wound or if the blood is flowing freely, whether bright or dark. Blood from arteries

is brighter than blood from veins and usually comes in spurts corresponding to the beating, or pumping action, of the heart.

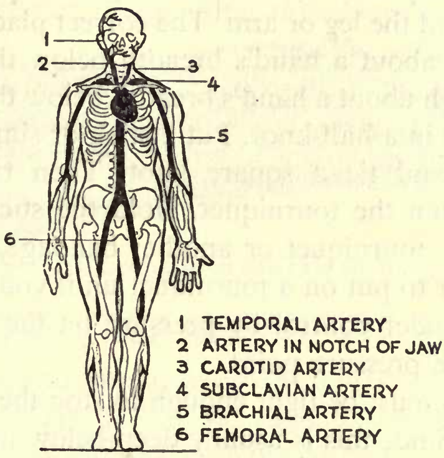
You do not need to decide, however, whether the blood is coming from an artery or vein. If it is coming fast and does not stop by itself within four or five minutes it is serious and you must try to stop it. Remember, the victim may have been bleeding four or five minutes by the time you reach him. So if you see a lot of blood on his clothes or see the blood pouring from a wound, go into action at once.

Direct pressure is the most commonly used way to stop bleeding. You may have to put your hand right on the wound. Sometimes pressing your fingers on the edge of the wound will stop the bleeding. If you have a sterile gauze compress, use it, but don't wait to get one. A clean handkerchief or cloth is better than your hand or fingers, but again, don't wait to find one. Depending on circumstances, you can send someone for a handkerchief or bandage, or the victim may be able to apply pressure while you get one. As soon as you can, substitute a cloth or dressing for you hands and fingers and press firmly on that. If this stops the bleeding, bandage the cloth or dressing tightly. Look at the bandage frequently to see whether bleeding has started again. If it has, you must apply more pressure. Don't take the bandage and dressing off, however. This might disturb or break the clot that is forming.

If the bleeding is from a wound in the neck, you cannot very well bandage a dressing in place. Put your hands above and below the cut and press firmly enough to stop the bleeding and keep up the pressure until a doctor tells you to stop. Because the blood will make the neck very slippery to hold, a compress of the cleanest material immediately available will be a great help in keeping the pressure on.

When bleeding is from the hands, feet, arms or legs, it may help to raise the injured part. If there is a broken bone, however, do not do this. Keep the injured part quiet, aside from the necessary manipulation to apply pressure and bandage and to raise it. Movement may loosen the clot and causing bleeding to start again.

A good way to stop serious bleeding in many cases is to press your hands or fingers on certain "pressure points." These points are where the main artery to the injured part lies close to a bone, which gives a firm object against which to press.



Pressure points on the body—

There are a number of these pressure points, but the two most practical for the first aider to learn and use are:

1. On the inner, or body, side of the arm, below the armpit and about halfway between shoulder and elbow.

2. In the mid-groin as the artery passes over the pelvic bone. Press downward, with your arm straight, pressing the heel of your hand into the middle of the groin.

TOURNIQUETS

You have undoubtedly heard about tourniquets used to stop bleeding. Remember that they are always dangerous. Applied by someone who knows how, they are useful, but they should not be used if bleeding can be checked by other means.

A tourniquet can be made from a belt, stocking, handkerchief or cloth folded to make a flat band at least two inches wide. Never use a rope, wire or sash cord. Tourniquets are most conveniently used on arms and legs. Wrap the flat material twice around the leg or arm. The correct places are around the upper arm about a hand's breadth below the armpit and around the thigh about a hand's breadth below the groin.

Tie the ends in a half-knot. Put a stick or similar article on the half-knot and tie a square knot. Then twist the stick swiftly to tighten the tourniquet. Hold the stick in place by the ends of the tourniquet or another bandage.

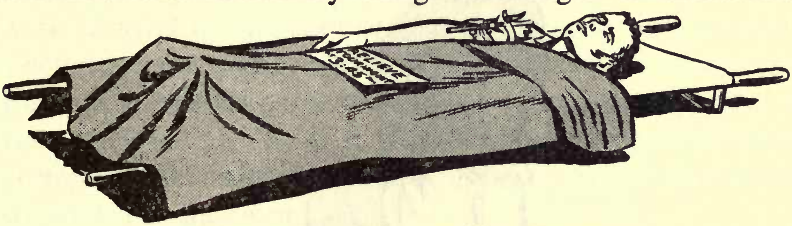
Don't bother to put on a tourniquet until you have brought the bleeding under control by pressure on the wound or on the appropriate pressure point.

Tourniquets must be tight enough to stop the flow of blood in the artery. Since this is usually deep below the surface, the tourniquet must be really tight or it will be worse than useless. One way of telling whether it is tight enough is to feel for the pulse at wrist or, if the tourniquet if on the leg, at the instep on the front of the foot between the ankle bones. If the flow of blood through the artery has been stopped, there will be no pulse. But it takes practice to know whether this is the case.

When you get the tourniquet really tight, you have cut off all blood to that arm or leg. If the circulation is cut off long

enough, the part dies and gangrene sets in. That is why standard first aid lessons direct you to loosen the tourniquet every 15 minutes, tightening it again if bleeding starts. Also, you must be careful not to cover a tourniquet with a bandage or splint, or it may be forgotten and not loosened when necessary. As an extra precaution, you can put the letters TK on the victim's forehead, using pencil, lipstick, a piece of charred wood or whatever is handy for marking.

As you can see, the use of a tourniquet is complicated. Unless you have had enough training to be expert, it may be wiser and safer not to try using this dangerous instrument.



Loosen the tourniquet every fifteen minutes—

12. THE TREATMENT OF BURNS

Burns and how to cure them are the hottest medical problem, thanks to the danger of A-bomb radiation added to the more peaceful accidents such as smoking in bed.

The best cure for burns is to prevent them. But if you are burned badly, the chances are you will get the best treatment the world has ever been able to give to burns.

Ugly, dangerous burns with the flesh literally cooked and charred and the skin totally destroyed are called third degree burns. The sign of a second degree burn is the blister, though you cannot always tell by this sign immediately, because the blisters may not form until hours or even a day later.

The first degree burn, unlike murder, is the least serious. The reddened skin of a mild wind or sunburn is an example of a first degree burn. The damage is confined to the most superficial layers of the skin which may "peel" in small powdery flakes. If you blistered after that day at the beach, however, you had a second degree burn. How sick you were depended on how much of your skin got seriously burned.

The red skin of a mild sunburn is an example of first degree burn—

The amount of body surface burned as well as the degree of the burn plays a part in the severity of the burn. Up to the time of the second World War, first degrees burns involving two-thirds of the body surface and, in adults, second-degree burns involving one-third of the body surface were generally fatal. But in 1945 a Navy surgeon could report the recovery and return to duty within three months of a young Marine who had second and third degree burns over 83% of his body.

To get such results requires practically the whole armory of medical weapons from gauze to vitamins and steaks and the

surgeon's skin grafting instruments. And it requires also a corps of trained medical personnel. Because of the tremendous amount of material and equally large number of persons needed to care for a single badly burned patient, present medical research on burns is aimed partly at finding ways to cut these twin bottlenecks without sacrificing the patient's recovery.

In the decade before World War II, tannic acid was widely used to treat burns. It was used either alone or in combination with silver nitrate, a purple dye called gentian violet, or a so-called triple dye. The idea was to tan the skin and produce a protective scab, medically termed an eschar. These substances were sprayed on the skin until a good eschar was produced. Then the patient was put to bed and covered with a heat cradle. Burn ointments for home use had tannic acid put into them and people were even told that, if they could not get medical aid promptly, they might start the tanning process by applying strong tea to the burn.

The tanning treatment, however, had to go on over a prolonged period and the results were uncertain. Pus can collect, undetected, under a tanned scab and may destroy valuable bits of skin not killed outright by the burn. In second degree burns, even severe ones, many of the deeper parts of the skin are spared and can regenerate new skin. The tanning treatment too often destroyed these important surviving bits of skin tissue. The difficulty of removing the scab was another disadvantage of this method.

MODERATE TREATMENT

Successors to the tanning treatment were: 1. Use of a sulfa drug, sulfadiazine, in triethanolamine spray to form a transparent, pliable scab, or eschar, through which pus formation

and other changes in the burned area could be seen. 2. Use of boric acid, in ointment or in fluid form under pressure dressings. This was abandoned when it was discovered that boric acid, previously considered a harmless, if weak antiseptic, could poison and even kill in some circumstances.

Discovery of the sulfa drugs and then of penicillin and other antibiotics has greatly aided the victims of severe burns. Infection has long been a major problem in burns, particularly those occurring in disasters in which the victims may have other wounds besides the burn. In the event of an atomic disaster, the infection problem is greater because radiation from the bomb reduces resistance to infection.

Medical scientists have not yet all agreed on the best method of fighting infection in burns. Some believe that sulfa drugs or penicillin or other antibiotics should be put directly onto the burn, usually in the form of an ointment, when the first dressing is put on. Others think it is better to put nothing on the burn itself except a sterile dressing or a sterile dressing impregnated with petrolatum. This group thinks the penicillin or other anti-infection drug should be given by hypodermic injection, as in the case of pneumonia or other infection, to be carried to the burned area and all other parts of the body by the blood stream. But, says the other side, this method of giving penicillin requires more trained personnel to give the hypodermic injections.

Both sides agree that when there are other wounds besides burns, as there are likely to be in the case of an atomic or other great disaster, "shots" of penicillin would have to be given to fight the danger of infection from the other wounds.

The solution may come, at least for atomic bomb burn victims, through aureomycin or some other antibiotic which is effective when given by mouth in pills or capsules.

One of the methods of treating burns now under trial in a couple of burn research centers, is the "exposure method." With this method, nothing is put on the burn. It is left completely exposed to the air, but the burned part is immobilized in some way. Good healing of superficial burns, without infection, in one to four weeks, has been reported with this method. Penicillin "shots" are given the patient as part of the treatment. How well this method works with deep burns that extend through all layers of skin tissue remains to be seen.

PRESSURE TREATMENT OF BURNS

Direct opposite of the exposure method is the pressure dressing which came into use during World War II and has continued in use since then. These are large pads of absorbent, resilient material bandaged on tightly and left in place for a week or 10 days. With this dressing pain is greatly relieved and almost all superficial burns, mild or deep, heal in one to four weeks if infection does not develop. Disadvantages, in case of disasters with mass casualties to be treated, are the amount of material and time and numbers of trained personnel needed to apply to dressings.

To cut this bottleneck, there is a new burn dressing consisting of fine mesh gauze next to the skin, a thick cellucotton pad and a tough outer layers of cotton. This all-in-one-section dressing can be put on quickly and its application should need only supervision by a doctor, thus freeing him to supervise treatment of large numbers of patients at one time. This dressing is now getting experimental trials in two large clinics where many burns patients are treated.

Nylon is also on trial as a burn dressing. English doctors have been trying Nylon bags to cover burned hands and pieces

of Nylon to cover other burned areas. Advantages are that it can be put on fast, it can be sterilized in an autoclave, does not tear easily, is transparent in the form used so that the doctor can watch the progress of the burn without removing the dressing, allows unrestricted movement of the burned part, and should be cheap if mass-produced.

If fluid collects over the burn, the doctor can stick a sterile needle through the Nylon dressing or bag, suck out the fluid and seal the tiny needle hole instead of having to remove the entire dressing and put on a fresh one. Needed for more effective use of this dressing is a method of sealing the Nylon to the skin around the edges of the burn.

Regardless of what kind of dressings are used or whether none are used, good burn treatment dictates that everyone in attendance on the patient, from the surgeon who dresses the burn to the nurse or orderly who gives bedpans, should wear a mask. This is to cut down the chances of infection from germs that even healthy people may be carrying in their noses and throats.

PREVENTING PAIN

As everyone knows, burns are painful. Flash burns, such as come in atomic attacks and also in explosions, are superficial but extremely painful. Small doses of morphine or codeine do a good job of relieving pain in superficial burns, such as the flash burns of an atomic attack, and even in deep burns, especially when the burn is covered. The covering of the burn alone does much to relieve pain and this is one reason medical scientists have been working hard to find good simple ways of covering burns without contaminating them, for use in large scale disasters.

Morphine, however, may turn out to have another important value in treatment of burns besides that of relieving pain. It may reduce the swellings, from accumulations of fluid, known medically as edema, which come with severe burns. In studies with guinea pigs, scientists have found significant decreases in the swellings with increasing doses of morphine. In this study, the laboratory animals were all burned with a measured amount of heat so that all had the same kinds of burns and the effects of various treatments could be determined accurately by comparing treated with untreated but identically burned animals.

The morphine that reduced the swellings in these animals was given before the burn, so one of the big questions to be answered is whether it will be as effective for this purpose when given after the burn. The studies are still going on and it is not known yet whether the preliminary results will prove out, especially when applied to burned humans instead of burned guinea pigs.

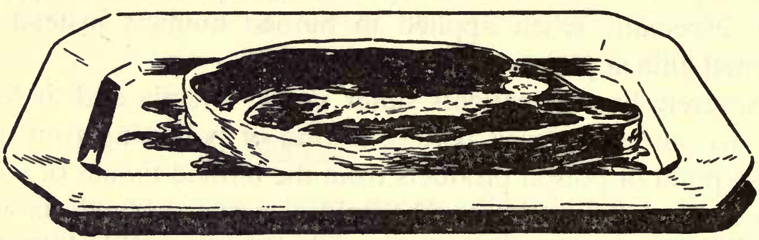
Severely burned patients suffer shock, anemia and, if they survive, the first shock period, a kind of poisoning from the absorption of poison products from the burned tissues or from infection or both. Plasma, the fluid part of the blood, as well as red blood cells are lost from the blood stream into the burned tissues.

BLOOD TRANSFUSIONS

Plasma and blood albumin help fight the shock. But severely burned patients need whole blood as well. As one Army doctor puts it, burned patients "seem to burn up transfused blood." When a pint of whole blood is given to a burned patient, there is not the increase in red blood cells that would be expected

and would come from transfusing a pint of whole blood to a patient sick with some other wound or illness. An A-bomb burn victim needs even more blood, because the radiation from the bomb damages the blood forming organs in his body. This makes him easier prey, also, to germs not only in the burn or other wounds but to those of pneumonia or strep sore throat or others which a previously healthy person could fight off easily with the aid of a sulfa drug or antibiotic such as penicillin. Atomic bomb burn victims need whole blood to save them until their own blood making organs have recovered and are on the job again.

Because the burn patient loses the fluid part of the blood, this also must be replaced, as must salt and other minerals. Vitamins, plasma, albumin, whole blood and salt solutions are given by vein and as soon as he can drink and swallow, fluids of all kinds are "forced."



Steaks or their equivalent in protein are a must in the diet of the burn patient—

Cortisone, adrenal gland hormone famous for its beneficial effects in arthritis, might become part of the future treatment for severely burned patients. Many doctors have already been using adrenal gland extracts, but recent experiments with guinea pigs show that the death rate can be halved if cortisone is given along with treatment for shock during the first critical days after the burn. The cortisone would tide

the patient over the critical "toxic" period between the third and tenth days after the burn when some patients, even with no infection, who have survived the initial shock, still die. Whether cortisone is used for this purpose, of course, will depend on two things: 1. Whether the guinea pig results prove out in humans, and 2. Whether enough cortisone ever becomes available.

Steaks or their equivalent in good protein are a "must" in the diet of the burn patient. The protein ration should be at least 125 grams per day. That is four ounces or more, and the four ounces means protein, not just meat. It would take at least a pound of sirloin steak, weighed without the bone, to furnish four ounces of protein.

Because of the vast amounts of blood that would be needed to save victims of atomic attack, scientists are vigorously pushing research on blood substitutes. More correctly, these should be called plasma substitutes, because so far no one knows of any real substitute for whole blood. Of the plasma substitutes, useful for fighting shock and therefore important, dextran seems at present to hold most promise. This is a Swedish product developed, during World War II, from a byproduct of sugar manufacture.

Being pushed also, under the American Red Cross national blood program, is research into ways of keeping whole blood or red blood cells longer. At present, three weeks is the limit of the useful life of red blood cells and therefore of whole blood that has been drawn from the body. Any material extension of this time limit would make possible stockpiling of blood on a larger scale for use in case of large scale catastrophes.

Third degree burns, in which all the skin is destroyed, are the ones in which skin grafting is needed unless the burn is

small in area. These also are the burns with ugly scars that contract as they heal, pulling flesh out of shape and, when they cross joints, making movement difficult or impossible. Burns of the neck, hands, elbows and other jointed parts of the body are therefore given special care to prevent these often crippling contractures. Early skin grafting is usually done for this purpose.

Another class of burns are chemical burns. First step in treatment of these consists in washing off the chemical with large quantities of water. If the burn was from an acid, an alkaline solution, such as soda in water, if available, would be useful because it would counteract the acid.

While the treatment of burns is enormously complicated, burns are burns, whether they come from an atom bomb, the sun's rays on the beach, a chemical, or the steam from the tea kettle on the stove.

FIRST AID FOR BURNS

In case of burns, the first aider's duties "are to relieve pain, prevent infection and treat shock."

Those directions, from the American Red Cross First Aid Textbook, will be especially important for you to remember if you are called on to give first aid in case of an atomic bomb attack in your community.

Burns are expected to make up anywhere from one-fifth to one-half the casualties in such an attack. Estimates based on the Japanese experience may be too high, because with any warning of the attack, large numbers of people should be able to find shelter from the heat flash accompanying the bomb burst. If fire-fighting plans now being made are carried out, it should be possible to reduce the number of burn casualties.

still further, because many of these were caused by uncontrolled fires after the atom bombing in Japan.

Several thousand severe burn casualties, however, can be expected in any community that is atom bombed. It is to care for these, as well as for the victims with serious bleeding, broken bones and torn and mangled flesh, that 20,000,000 lay persons must be trained in first aid.

Treatment of patients with severe burns requires morphine, bandages, penicillin, blood, blood plasma and plasma substitutes, salt and fluid replacement and special diets. But except for the bandages, these measures all will have to be given in hospitals or burn stations by doctors, nurses and other specially trained personnel. Some of you may through your local civil defense organization be called to take this special training for work on a burn team. But everyone can learn the simple, immediate first aid treatment for burns, whether caused by atom bombs or an upset pot of boiling liquid on the kitchen stove.

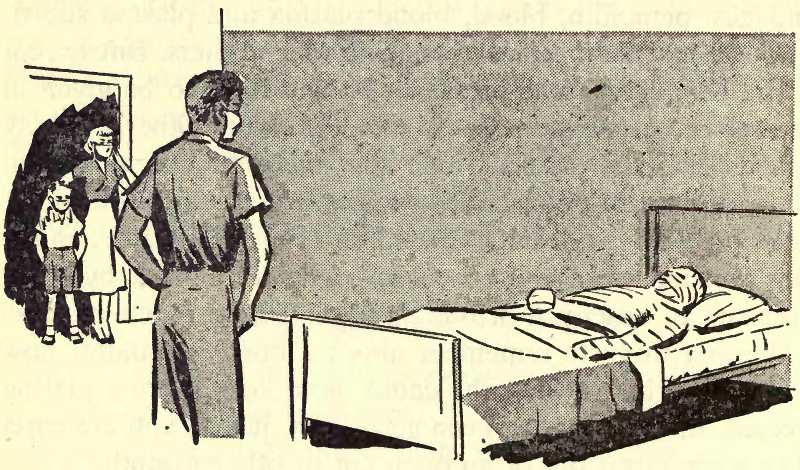
The first thing to remember about a burn, no matter how severe or slight, or what the cause, is to keep it from getting infected. In other words, keep germs out, just as you are careful to keep germs out of an open cut or other wound.

You might think that a burn would be sterile, all the germs killed by the heat that seared the flesh. Hospital experience, however, shows that this is not the case. Patients arriving in hospitals for burn treatment almost always have some infection in the burn. Penicillin and other modern germ-fighting drugs play a tremendous part today in saving the victims of burns. But these drugs are for use by doctors, not first aiders.

Your role as a first aider treating a burned patient is to keep any more germs from getting into or onto the burn. If you can get the patient to a doctor, hospital or burn station

quickly, you do not need to put anything on the burn. Watch to see that clothing does not brush against it, and that no one coughs, sneezes or weeps into or onto the burn.

In case of an atom bomb attack, and often in other cases of burn injuries, it may not be possible to get the victim to medical aid very quickly. In such a case, put a sterile dressing on the burn to cover it and protect it both from the air and from germs.

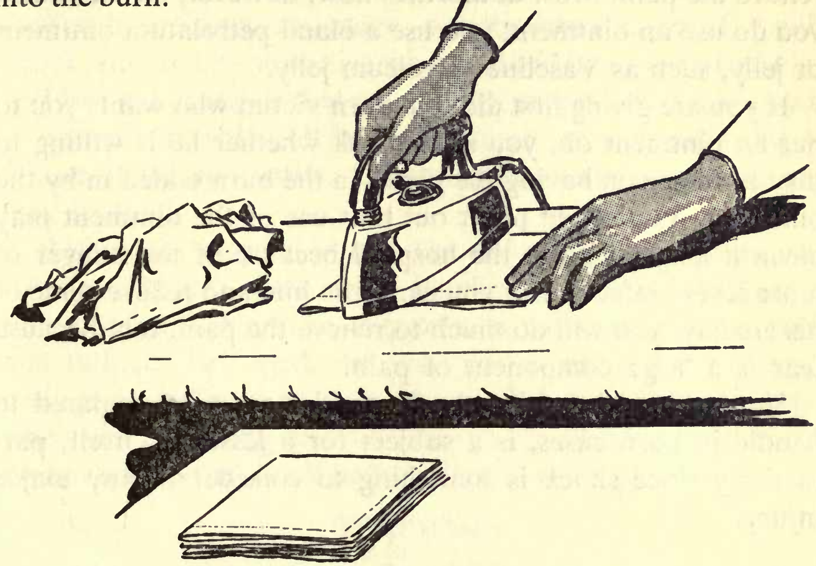


Keep any more germs from getting into or onto the burn—

The sterile dressing will help ease the pain. Any covering over a burn helps to stop the pain, but do not use just any covering. At Hiroshima people put rice flour, raw ground potato and cucumber juice on burns. This, one burn authority says, "undoubtedly accounted for the widespread subsequent infection" though these substances apparently did relieve pain.

If you have not sterile dressings at hand, use the very cleanest cloth you have. Ironing the cloth or heating it in an oven will make it more nearly sterile and germ-free. Be care-

ful when you put the dressing on and bandage it in place to avoid touching the burn or coughing or sneezing near it. Nurses and doctors in hospitals wear face masks, you know, when dressing a burn to keep germs from their breath getting into the burn.



Ironing the cloth will make it more nearly sterile—

If the first sterile dressing does not relieve the pain, put another one on top of the first, without disturbing the first one. The second one very likely will stop the pain.

You can reasure a burn victim who complains of the pain by telling him that the painful burns are not the serious ones. This is because in serious burns, the nerve endings are destroyed and the patient does not feel any pain. Do not, however, tell this to the burn victim if he does not complain of pain.

Many people have a tube or jar of medicated burn ointment in the home medicine chest or first aid kit. Tannic acid was

once widely used by doctors to treat burns and ointments containing it were widely sold. Later, doctors found that tannic acid was not good medicine for burns and now they do not advise it. Some burn ointments have medicines in them to relieve the pain. Most authorities now, however, advise that if you do use an ointment, you use a bland petrolatum ointment or jelly, such as Vaseline petroleum jelly.

If you are giving first aid to a burn victim who wants you to put an ointment on, you should ask whether he is willing to take a chance on having the germs in the burn sealed in by the ointment. You might point out that use of the ointment may mean a longer stay in the hospital because of the danger of more severe infection. If you can calm him and relieve some of his anxiety, you will do much to relieve the pain, too, because fear is a large component of pain.

Shock, the third thing the first aider must be prepared to handle in burn cases, is a subject for a lesson in itself, particularly since shock is something to consider in any major injury.

13. THE TREATMENT OF SHOCK

Severe bleeding, bad burns, broken bones, crushing injuries, shell, bomb and bullet wounds all call for treatment of shock. And because shock is easier to prevent than to cure, first aiders are taught to bring treatment immediately without waiting for symptoms of shock to develop.

The work shock is used to describe many different conditions, and some of you may therefore be confused about it. We speak of a person having a great shock when he has suddenly received bad news. Emotional or nervous shock may cause

fainting. Fainting is in some ways like the shock from severe injury, but is different in being quickly reversible. Lowering the patient's head usually revives him at once.

Electric shock is a definite injury for which first aiders get special instruction. A kind of shock called chemical shock is caused by poisons, and many persons have heard of insulin shock, suffered by diabetics who get too big a dose of insulin.

The kind of shock that comes with severe injuries is a state of collapse in which all body functions are depressed due to failure of the circulation. Severe shock is always serious and may be fatal.

Besides the original injury, the following factors may contribute to shock: pain, rough handling, improper transportation, continued bleeding, exposure to excessive heat or cold, and fatigue. The aged, the very young and the discouraged are apt to suffer more from shock. Remember these factors when you are giving first aid to an injured person, so that you do not add to the shock he has already suffered.

SYMPTOMS

Most common symptoms of shock are paleness, a cool, clammy skin and a feeling of weakness or faintness. Perspiration on the forehead, around the lips and on the palms of the hands is another symptom. A weak, sometimes rapid pulse, nausea and vomiting are symptoms of shock. The patient in shock is often indifferent to what is going on around him and to questioning. Unconsciousness is also a symptom of shock.

These symptoms may not all show in one patient. Usually they develop gradually and the victim may seem perfectly all right at first, only to collapse later. Even a patient in deep shock may not show signs that the first aider can detect.

For these reasons, first aiders are taught that persons with even minor injuries should lie down, and that in every case of serious injury, shock should be treated. The only possible exception to this rule would be in the event of an atomic attack or other large scale disaster in which the first aider's first job after stopping severe bleeding might be to get the injured person out of the hazard area.

Loss of blood is one cause of shock, so when you stop the bleeding you are also helping to overcome the shock, or at least to keep it from getting worse.

FIRST AID FOR SHOCK

First aid directions for treating and preventing shock cover four points:

1. Position. Keep the patient lying down flat. If the injury is severe, raise the lower part of the body a foot or so. If a chest injury makes it hard for the patient to breathe, raise his head and shoulders slightly and keep the legs flat. Never force an injured person to stand or walk except in the unusual situation where you may have to get him away from flames or falling walls. Even then, it would be better to have him carried.

2. Heat. The idea is to keep the patient comfortable but not too hot. The old idea of applying heat to a patient in shock has been revised because it is now known that coldness of hands and feet in such cases is due in part to constriction of the blood vessels. This is the body's way of making up for the deficiency in circulation. So you try to conserve the body's heat without adding too much to it. The simplest method of doing this is to cover the patient with blankets, coats, newspapers or whatever is at hand. Remember to put the covering under as well as over him, to protect him from the coolness and possible

dampness of the ground. In hot weather, a small amount of covering may be enough. You do not want your shocked patient sweating. In very cold weather you may use hot water bottles to keep his body from losing heat. Be careful not to burn him. He may not feel the heat or be able to tell you it is too hot, but can nevertheless get a burn from too hot a water bottle.

3. *Fluids.* Don't give an unconscious patient anything to swallow and don't try to pour fluids down his throat. But if the patient is conscious and can swallow, and is not nauseated, small amounts of warm water, broth, milk, tea or coffee may be given. The fluids will help keep him warm and will help replace the fluids he may have lost in blood due to the injury. A cupful every half hour is enough. You may need to feed it from a spoon.

4. *Other measures.* Do not give stimulants. They have no value in the first aid treatment of shock. Avoid unnecessary questioning and handling of the patient, but care for other injuries.

14. HOW TO FIGHT FIRE

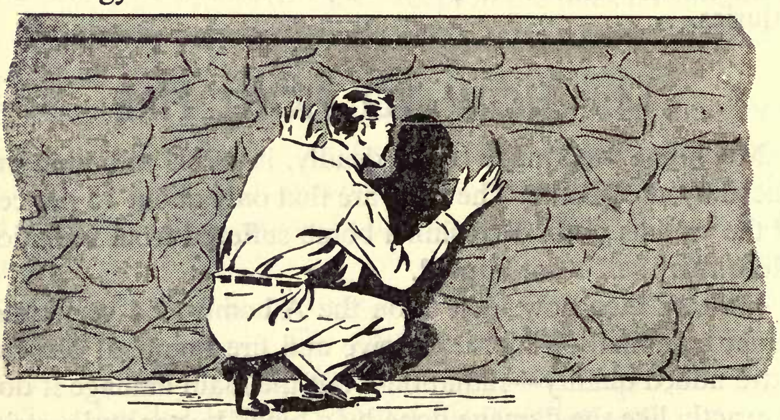
Much has been made of the deadly, invisible radiation produced by an A-bomb. The facts are that only about 15 per cent of the victims of the Hiroshima bomb suffered from radiation. More than half were burned.

Military men now look upon the A-bomb as a very much larger combination high explosive and fire bomb. It has that extra added quality—radiation—but the main damage it does is exactly like the damage done by a block buster and a string of incendiary bombs, multiplied many times.

The A-bomb is a very much larger combination high-explosive and fire-bomb—

If you are far enough away from ground zero—and many thousands of people will be if and when an A-bomb falls—your only immediate problem might be how to save your home from burning down.

The ball of fire from an A-bomb explosion reaches an internal temperature of more than 1,000,000 degrees, centigrade. This energy is liberated in the form of thermal radiation—a



Being behind a tree or wall may protect you from the burns of thermal radiation—

short, extremely hot heat wave—lasting only about three seconds.

The brevity helps. At reasonable distances, from ground zero, being behind a tree, a wall or even a thin layer of light colored cloth protects you from the burns caused by thermal radiation. Thermal radiation may ignite many wood surfaces, but the blast of wind caused by the explosion comes along and puts out most of the fires started that way.

However, this is not the end of danger from fire. The shock wave from the bomb, cutting gas mains, knocking over stoves and furnaces, scattering fires from open fire places, creating electrical short circuits, accentuates all the minor fire hazards of daily life. Lots of little fires will break out.

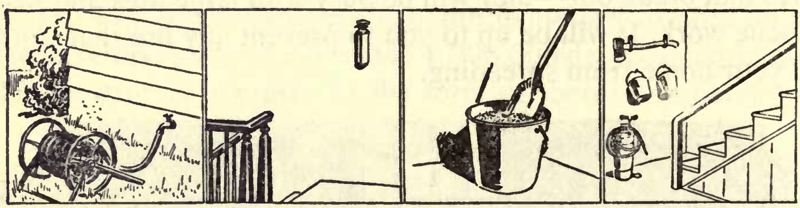
The A-bomb blast is bound to knock out some of your city's fire equipment. The rest will not be able to cover all the small fires that break out—they will be busy with large fires and with rescue work. It will be up to you to prevent any fire that starts in your home from spreading.

Each home must be made reasonably fireproof—

FIRE PREVENTION

It might be a good idea to look around your home or place of business right now with the eager eye of a firebug looking for a good place to start a fire. How is the attic? Piles of paper, dried out clothing which will burst into flames? Do you have half-full cans of old paint stuck in a closet some-where? How about containers of kerosene or gasoline? Is your electric wiring strong and well protected? Do you know where to turn off the pilot light in your gas stove and how to cut off the gas supply?

If and when a national emergency or an all-out war starts, you will want tools for immediate fire fighting around your house or place of business. These includes buckets of sand, shovels, axes, commercial fire extinguishers, stirrup pumps and, if you have a lawn, an always-connected garden hose.



The tools for fire fighting should be kept in your house—

Authorities divide on the issue of the filled bathtub. Everybody filling their bathtubs during and air raid brings the pressure in the water mains down and makes the job of the regular firemen that much harder. It might mean the difference between saving your house and seeing it burn to the ground.

However, a little water might be a great help if there is a small fire in your home and the water has been cut off. The best advice is—if you have not filled your tub when an air raid alert sounds, leave it empty. After an alert and during an

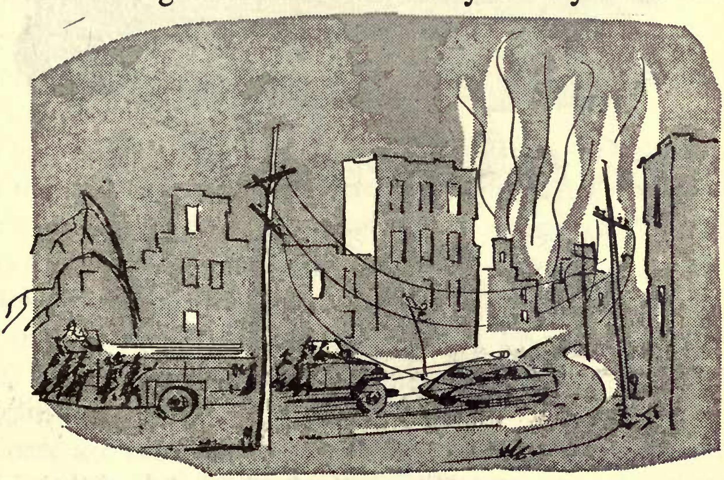
air raid, only turn the water on for essential reasons or if a fire actually has started in your home.

You may well have to fight a small fire in your home all by yourself or with the help of neighbors. If, despite your efforts, it begins to spread, it is possible that the organized fire fighting services of civil defense will be able to come to your help.

It must be emphasized that whether they come depends on many factors, the least of which is how much you love your home. The most important is the availability of equipment and fire fighters. Controlling the spread of fires near or in vital installations, preventing the many little fires from becoming a wild thing which would sweep over the citty unchecked—that will be the job of the firefighters from your city and surrounding communities.

THE FIRE DEPARTMENT

The fire department of your city is, in a sense, already a civil defense organization. It defends your city from disaster.

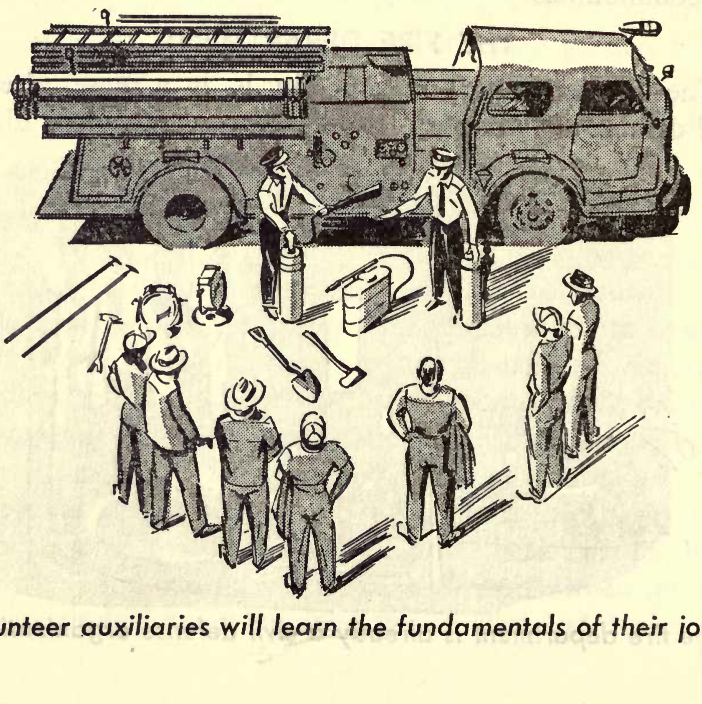


The fire department is already a civil defense organization—

It is already trained to perform rescue, handle victims of burning or explosions, protect dangerous buildings and carry on salvage and restoration. Firemen's thinking requires little transition from peace to war—only expansion.

Individuals fire companies know that, when a fire in their precinct gets too big for them to handle, an already functioning system will bring them help from neighboring companies. This system, greatly expanded, both as to men and equipment, will be the basis of our civil defense against fire from the A-bomb.

Your city's civil defense service will do three things—train thousands of auxiliary firemen, enter into mutual aid agreements with the fire departments of suurounding cities and towns, and plan the city's physical defenses against fire.



Volunteer auxiliaries will learn the fundamentals of their job—

Training programs have developed in each state many competent firemen who can serve as instructors to the volunteer auxiliaries. In thousands of towns and smaller cities, the tradition of volunteer firemen is still alive. Volunteer auxiliaries are as American of the thousands of firehalls. But the burden of instruction of the auxiliaries will fall on the thousands of regular, full-time firemen in the nation's larger cities.

VOLUNTEER AUXILIARY FIREMEN

Volunteer auxiliaries ought to be able to learn the fundamentals of their job in about 30 hours of instruction—perhaps, as suggested by the National Fire Protection Association, in ten sessions.

If you volunteer for the auxiliaries, your first lesson will probably be about the tools with which you work. How does a pumper work? What about the booster tank? How long will it supply one and a half inch streams with various sizes of nozzles? What do you do with extinguishers, axes, hose, bars, rope tools, gas masks, lighting equipment? Do you know your knots? Many of you will already know some of this, carrying this knowledge over from your daily occupations.

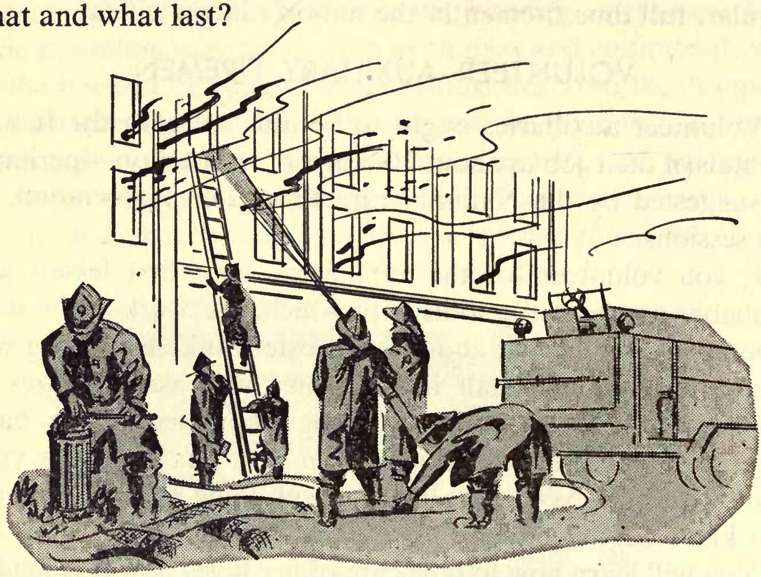
You will learn how to take care of fire hose, how it is loaded into the truck, how it is washed and dried after use, and the difference between cotton rubber-lined hose and the rubber-lined hose with rubber cover.

How do experienced firemen get the hose off the truck and into operation so quickly? What is the best way of carrying a hose? Should you lay the hose from fire to hydrant or from hydrant to fire?

There are efficient ways to carry a ladder, safe and efficient ways to set it in a window or against a cornice. You will prac-

tice carrying a dry line up a ladder, making the necessary ties to the ladder and operating a stream.

Finally, the principal features of fighting fires in factories, dwellings and small stores will be taught you. What is different about how you attack fires which originate in basements, attics, partitions or chimneys? What do you do first, what next, then what and what last?



There are efficient ways of handling fire-fighting equipment—

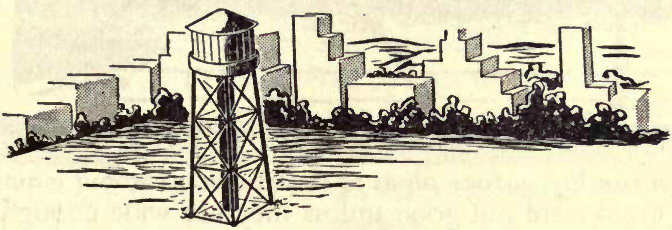
Although many fire departments are now planning to train at least twice as many auxiliaries as they have regular firemen —that won't be enough. Large cities will have to depend on surrounding communities—sometimes as far away as 100 miles for help in fighting fires started by an A-bomb.

Most states either have passed legistlation or will soon do so giving cities the authority to make mutual aid agreements with their neighbor cities, whether or not they lie across a state

border. Right now benefits to firemen, in many cases, stop at a city's border. These agreements will take care of that situation. And they will permit the fire chiefs of neighboring cities to find out whether their equipment is interchangable, whether one city's hose will fit into the other city's hydrants. Fire personnel will become familiar with the layout and the fire fighting methods of the departments in nearby cities.

Help will come too from within a city. In addition to the regular, public fire departments, many large factories have their own fire protection divisions. For civil defense, these will be integrated with the regular and auxiliary fire departments.

MAKING A CITY FIREPROOF

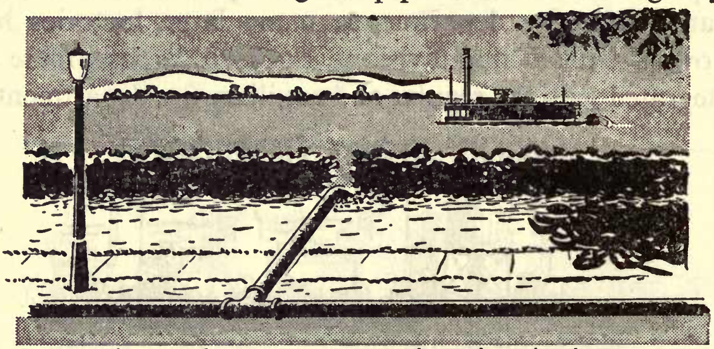


Cities can be protected against uncontrollable fires—

City planners are giving thought to making cities fireproof —or at least to how to keep fires from spreading out of control in our cities. There are two things to be done: 1. Auxiliary water supplies, 2. Fire breaks.

Of these, the first will be easier. The most probable kind of A-bomb burst over our cities will probably not knock out water mains. But it will spring innumerable leaks in water pipes. Quick work with the valves will be necessary to maintain the vital pressure needed by our firefighters. Good initial planning will make sure this quick work is done. But this may not be enough.

Your city's fire department and water works will cooperate in finding out how to tap nearby lakes and streams, providing auxiliary pipe lines from these sources. They may establish huge tanks in strategic areas. The firemen will learn how to lay pipelines on the surface at the greatest possible speed to replace bombed out pipes when water is needed quickly. If necessary the water works will figure out ways of carrying impure water from rivers and lakes in regular pipelines in an emergency.



Firemen can lay surface pipes to replace bombed-out mains—

Fire breaks are not good unless they are wide enough. Experience in the fire-bombed cities of England, Germany and Japan showed that a break had to be 100 yards wide to be effective. City planners are figuring now, what buildings should come down, how to utilize natural fire breaks, like wide avenues and streams.

It will depend, of course, on how urgent each city feels is its situation whether or not fire breaks are constructed. Some cities even now see this as an opportunity of combining slum clearance with greater safety for the citizens.

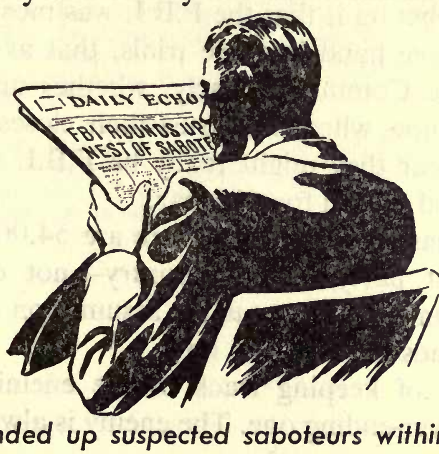
The A-bomb is the greatest incendiary bomb yet made. To minimize the damage it does by fire, every citizen will have to cooperate.

15. PREVENTING SABOTAGE AND LOOTING

The enemy, if and when he strikes in an all-out war and, if and when he uses the A-bomb on our cities, will attempt to supplement the damage done to our will and ability to resist. He will turn to enemies within our gates for this job—for subversion and sabotage.

Our defenses against these two dangers are much more sure than our defenses against the A-bomb. For one thing, they are nothing new. Governments and peoples have been dealing with them since the beginning of conflict between man and man.

Just as in our defense against the A-bomb, there are two parts to defense against sabotage and subversion, active and passive. And just as with defense against the A-bomb, there are trained professionals to take care of the active side of things. In this case it is the Federal Bureau of Investigation—aided by the state, city and county law enforcement agencies.



The F.B.I. rounded up suspected saboteurs within hours of Pearl Harbor—

You will remember that during World War II there was hardly one case of sabotage worth a big headline—there were few attempts made to subvert our war effort. This was primarily because the F.B.I. had done a quiet but effective job before the war started in putting the finger on the boys who were set to cause trouble. They were rounded up within hours after the bombs dropped on Pearl Harbor. Foreign employers of these spies did not get much for their investment.

The F.B.I. was first given the job of investigating espionage, sabotage, subversive activities and related matters by President Roosevelt in September, 1939. Its effectiveness was demonstrated in World War II.

Now, once again faced with the threat of war, the F.B.I. is once again on the job. Some evidence of their work has come to light. Witnesses in the trial of 11 top Communist leaders turned out to be F.B.I. agents who had posed for years as members of the Communist party, who had gained some of the innermost secrets of that party.

But we may bet on it that the F.B.I. was most certainly not showing its whole hand in these trials, that as you read this members of the Communist party, whether underground or overt, do not know whether to trust their closest associates in the party for fear they might really be F.B.I. men. They no doubt have good reason for this fear.

The F.B.I. has estimated that there are 54,000 members of the Communist party in this country—not enough to fill Yankee Stadium. It is a reasonable assumption that the F.B.I. knows where most of them are now.

Yet the job of keeping track of the enemies within our country is a never-ending one. The enemy is always trying new tricks, using new personnel.

THE WHITE HOUSE
WASHINGTON

July 24, 1950

INFORMATION RELATING TO DOMESTIC ESPIONAGE, SABOTAGE, SUBVERSIVE ACTIVITIES AND RELATED MATTERS

On September 6, 1939 and January 8, 1943 a Presidential Directive was issued providing that the Federal Bureau of Investigation of the Department of Justice should take charge of investigative work in matters relating to espionage, sabotage, subversive activities and related matters. It was pointed out that the investigations must be conducted in a comprehensive manner on a National basis and all information carefully sifted out and correlated in order to avoid confusion. I should like to again call the attention of all Enforcement Officers, both Federal and State, to the request that they report all information in the above enumerated fields promptly to the nearest Field Representative of the Federal Bureau of Investigation, which is charged with the responsibility of correlating this material and referring matters which are under the jurisdiction of any other Federal Agency with responsibilities in this field to the appropriate agency.

I suggest that all patriotic organizations and individuals likewise report all such information relating to espionage, sabotage and subversive activities to the Federal Bureau of Investigation in this same manner.

Harry Truman

ROLE OF THE CITIZEN

In the past, much valuable help has come to the F.B.I. from the average law-abiding American. Plain citizens have seen people do things which are wrong or which they suspect are wrong. These citizens have gone to the telephone and reported these things to the F.B.I. And many times what plain citizens have seen has been a detail in the information the F.B.I. needs.

Of course, millions of us will go through our lives never seeing a spy or a saboteur going about his business. Thousands of us may, at one time or another, think we see something like that. Only hundreds will be right. It would be foolish for all of us to see enemy agents lurking behind every tree, to become frightened of our own shadows and report them to the F.B.I.

But we are citizens, we might see something which might be useful to the F.B.I. and it is our duty to report what we see. It is also our duty to know what is useful to the F.B.I. and what isn't.

J. Edgar Hoover has said: "The F.B.I. is interested in receiving facts; we are not interested in what a person thinks but in what he does which undermines our internal security. Avoid reporting malicious gossip or idle rumors."

In other words, the F.B.I. is not a police state Gestapo—thank goodness. It is charged with the job of investigating the possible commission of certain specific crimes written into law by the people whom we elect. If you think your neighbor has "radical" views—that is none of your or the F.B.I.'s business. After all, it is the difference in the views of our citizens, from the differences between Jefferson and Hamilton to the differences between Truman and Dewey, which have made our country strong.

But if you see your neighbor—and the views he expresses might seem to agree with yours completely—commit an act which leads you to suspect that he might be committing espionage, sabotage or subversion, then report it to the F.B.I.

After that, forget about it. Mr. Hoover also said: "Do not circulate rumors about subversive activities, or draw conclusions from information you furnish the F.B.I. The data you possess might be incomplete or only partially accurate. By drawing conclusions based on insufficient evidence grave injustices might result to innocent persons."

In other words, you may be wrong. In our system, it takes a court, a trial and a jury to say a man is guilty.

Mr. Hoover went on to say: "Once you have reported your information to the F.B.I., do not endeavor to make private investigations. This can best be done by trained investigators who have access to data acquired over the years on individuals engaged in subversive activities. Hysteria, witch-hunts and vigilantes weaken internal security. Investigations involving internal security require care and painstaking effort. We all can contribute to our internal security by protecting the innocent as well as by identifying the enemies within our midst. In cases involving espionage it is more important to identify spies, their contacts, sources of information, and methods of communications than to make immediate arrests."

That last sentence is important. Once you know who a spy is, there are many things you can do with him besides arrest him. A spy is always only a small part of a network. If you know who he is, through him you can learn about the rest of the network. So, many times, spies are allowed to go about their business, seemingly free, but all the time being much more useful to us than to the enemy.

SABOTAGE

Millions now work in factories which contribute to our national defense and our national well-being. Millions more will go into factories if an all-out war comes. These factories have been guarding against sabotage throughout their existence. Much sabotage has nothing to do with enemy action. It can come from disgruntled employees, from carelessness. Enemy sabotage is the extra added attraction of war, but it can be handled in much the same way as peacetime sabotage. As a worker in a factory you can keep your eyes open for all kinds of sabotage and if you see something suspicious—report it to the authorities. Do not take direct action.

Fouling up the civil defense organization of a city during and after an A-bomb attack would be a logical objective of any enemy. When communications lines are set up, safeguards will be provided against sabotage of vital messages. The best defense against this kind of sabotage is to be well trained in your job. If you are you will know the people you will have to work with. And you will know that you can trust those people.

There may be a danger to you after an A-bomb attack which has nothing to do with enemy action, but which, if it occurs, will help the enemy. This is looting.

There are always some people who like to take advantage of disaster to other people. Sometimes these are only a few individuals, sometimes—especially in enemy countries during World War II—the looting fever spreads and almost everybody begins to help themselves.

A city which has suffered an A-bomb attack will have controls placed upon it similar to martial law. Your police will be helped in these controls by thousands of auxiliary police,

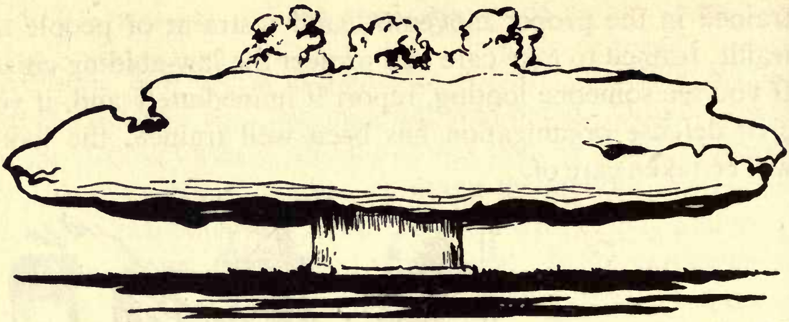
trained in the proper movement and restraint of people and traffic, trained to take care and protect the law-abiding citizen. If you see someone looting, report it immediately and, if your civil defense organization has been well trained, the looters will be taken care of.

A city which has suffered an A-bomb attack will have controls placed upon it similar to martial law—

16. THE HISTORY OF ATOMIC ENERGY

The practical release of atomic energy resulting in the atomic bomb was an achievement that is considered equivalent to the discovery of fire. Its consequences are world shaking, affecting military strength and international relations, as well as giving mankind a new source of power.

The atomic bomb project was the world's most gigantic scientific project, or as President Truman said in his 1945 announcement, "the greatest gamble in history."



The atomic bomb project was the world's most gigantic scientific project—

Historic dates in science's achievement of atomic power have been added to human chronology: January 26, 1939, when American physicists learned of European experiments showing that one of the uranium isotopes underwent fission with release of nuclear energy when bombarded with slow neutrons; December 2, 1942, when the first self-maintaining nuclear chain reaction was initiated in an uranium-graphite pile at Stagg Field Stadium, Chicago; July 16, 1945, 5:30 a.m., when the first atomic explosion created by man blasted the New Mexico desert; August 6, 1945, when the atomic bomb used in warfare was dropped on Hiroshima, Japan; August 11, 1945, when Nagasaki was bombed; September 23, 1949, when President Truman announced, "We have evidence that within recent weeks an atomic explosion occurred in the U.S.S.R."; January 31, 1950, when President Truman authorized continuance of work on the so-called hydrogen bomb.

HISTORY OF ATOMIC ENERGY

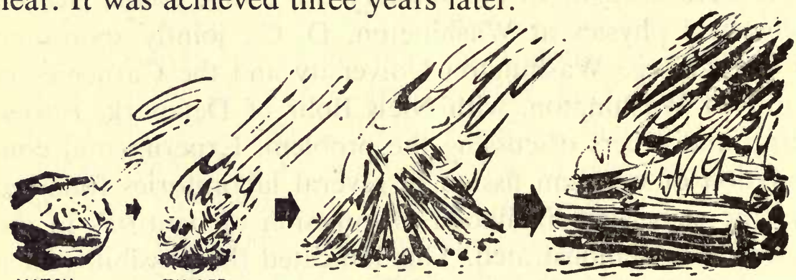
The story of the release of atomic energy really begins with many discoveries, experiments and theories in nuclear physics in the 1930's, but the immediate start of the researches

which resulted so spectacularly was in January, 1939, when two Germans, O. Hahn (awarded the Nobel prize in 1945) and F. Strassmann proved that an isotope of barium was produced by neutron bombardment of uranium. The neutron is a fundamental particle of matter without electrical charge and with a mass about equal to that of the proton or nucleus of the hydrogen atom. Two refugees from Germany, O. R. Frisch and Lise Meitner, suggested that the absorption of a neutron by a uranium nucleus sometimes caused that nucleus to split into approximately equal parts with the conversion of some of the mass, by Einstein's 1905 formulation ($E = mc^2$), into enormous quantities of energy, a process called fission. These reports were brought to the January 26, 1939, conference on theoretical physics at Washington, D. C., jointly sponsored by The George Washington University and the Carnegie Institute of Washington, with Niels Bohr of Denmark, Enrico Fermi and others discussing the problem. Experimental confirmation of uranium fission in several laboratories followed and the suggested likelihood of emission of neutrons in the process was demonstrated. This indicated the possibility of a chain reaction releasing energy explosively, the neutrons produced splitting asunder other uranium atoms and producing more neutrons as well as energy.

The world's common sources of power, other than sunlight and water power, are chemical reactions, such as the combustion of oil and coal. They release energy as the result of rearrangements in the outer electronic structures of the atoms. This is the same kind of process that supplies energy to the living body. Combustion is self-propagating. A match releases enough heat to ignite the neighboring fuel, which in turn releases more heat which ignites more fuel. Similarly, nuclear

reactions may emit particles of the same sort that initiate them and they may be sufficient in number to propagate the reaction in neighboring nuclei. This is called a chain reaction, and it is this sort of reaction, accompanied by release of energy, that occurs in the atomic bomb.

By June, 1940, just after the fall of France, when scientists voluntarily restricted publication of papers on the subject of uranium fission in scientific journals, it was known that slow neutrons caused fission in one isotope, uranium 235, but not in the other, uranium 238. It was known that the average number of neutrons emitted per fission was between one and three. A chain reaction had not been achieved but its possibility was clear. It was achieved three years later.

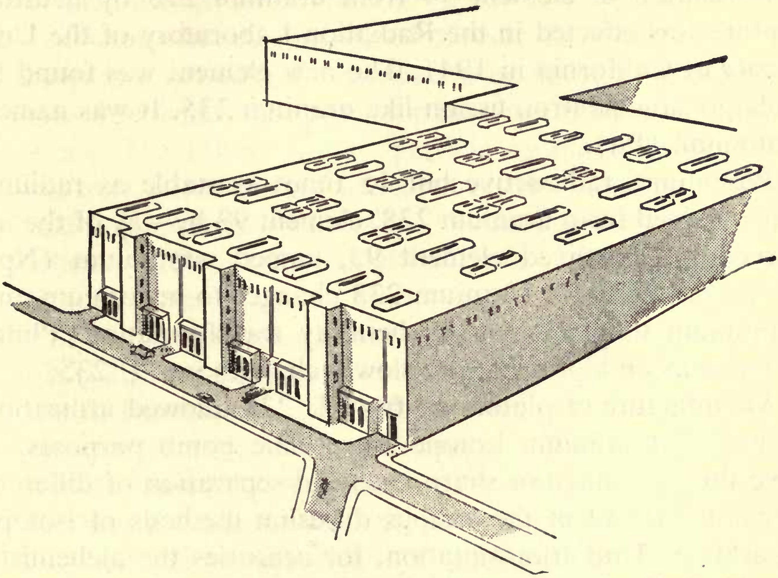


A chain reaction accompanied by release of energy occurs in the atomic bomb—

What happened after the curtain of war secrecy was lowered was not revealed until August 10, 1945, when the War Department released as a part of its atomic bomb explanation the now famous Smyth report, a semi-technical report on the processes by which the use of atomic energy for military purposes had been achieved. It was written by Dr. H. D. Smyth of Princeton at the request of Maj. Gen. L. R. Groves, U. S. Army, who headed the "Manhattan Project," as the Army

called the atomic bomb project during the war. It is available as a government document from the Superintendent of Documents, Washington, D. C., at 35 cents. Much of the technical and scientific data about the atomic bomb that can be published without violation of security regulation are contained in this report. The atomic energy project during the war cost two billion dollars.

FISSION OF URANIUM



An enormous isotope separation plant was erected at Oak Ridge—

In order to make the fission reaction in Uranium 235 self-sustaining, it was found necessary to separate uranium 235 (less than ½% in any uranium sample) from the more abundant isotope uranium 238 (more than 99%). The more common kind prevents the chain reaction by absorbing neutrons. For this purpose an enormous isotope separation plant,

using gaseous diffusion methods, was erected at Oak Ridge, Tenn. Much of the experimental work for the whole project was done there.

Two new elements, heavier than uranium, both of which were "made to order" and neither of which was known to exist in nature, played an important part in the atomic bomb researches and manufacture. These were elements numbered 93 and 94 in the periodic table.

Formation of element 94 from uranium 238 by neutron capture was effected in the Radiation Laboratory of the University of California in 1941. The new element was found to undergo slow neutron fission like uranium 235. It was named plutonium (Pu).

Plutonium, radioactive but 15 times as stable as radium, was obtained from uranium 238, element 92 by way of the intermediate shortlived element 93, named neptunium (Np) discovered in 1940. Uranium 238 changes to neptunium and neptunium to plutonium by beta-ray transformation. Plutonium emits an alpha ray and slowly changes into U 235.

Manufacture of plutonium from U 238 allowed utilization of the inert uranium isotope for atomic bomb purposes. It gave the advantage of sharp chemical separation of different elements instead of the tedious diffusion methods of isotope separation. Thus transmutation, for centuries the alchemists' goal, became the method of choice of the group of scientists who worked out the chemistry of the atomic bomb.

SEPARATING THE KINDS OF URANIUM

The problem in purifying fissionable material for the bomb was to separate the kinds of the rare metal uranium, which have a very slight difference in weight. To separate them by

this difference was slow and tedious, especially since the part valuable for actual use in the bomb makes up less than one part in a hundred in any quantity of the ore.

Here the knowledge and skill of chemists who have studied the behavior of radium and other radioactive elements were put to good advantage. It has been found in work with such elements that their weight and their chemical nature depend on two kinds of minute particles which make up the hearts of their atoms.

The number of one kind of particle, the proton, in the atom heart is responsible for the nature of the element. One proton makes hydrogen, 26 protons make iron, 92 protons make uranium. The other kind of particle in the atom heart is the neutron. Uranium 235 has a net result of 92 protons and 143 neutrons, adding up to 235, according to the chemists' calculations, while uranium 238 has three more neutrons than its lighter isotope.

These two uraniums had to be separated, because only uranium 235 would split up the way the scientists wanted it to for use in the atomic bomb. Uranium 238 would not. By lucky chance, the very property of uranium 238 which made it useless for the purposes of the bomb provided the clue which was the best solution of the separation problem.

The more plentiful form of uranium 238 could be made to undergo transformation into another kind of element by first adding to the nucleus of its atom a neutron, to make it so heavy that it would become unstable, then by allowing this heaviest uranium atom to shoot an electron out of its structure. This loss of electrons from the total quantity of uranium showed itself as a phenomenon familiar to scientists as the beta ray. It is the peculiar nature of radioactive elements to change into

something else when they emit beta rays, and that something else is, oddly enough, not a lighter but a heavier element.

Accordingly, when unstable uranium 239, formerly the heaviest known element, emitted its beta ray it changed into a still heavier element, neptunium. Neptunium proved to be a rather unstable element, and emitted a beta ray in its turn. This change in the atom turned neptunium into another new element, plutonium. The names of these three elements are taken from the three farthest planets of our solar system.

Plutonium turned out to be a fairly stable element, about whose chemical properties enough was soon learned to prove that chemical separation of this new material from its parent uranium would be a relatively easy task. Plutonium does not readily follow the pattern by which it was formed, but eventually makes the opposite transformation by which it gives off an alpha ray and turns into uranium 235.

Plutonium is the material used in present atomic fission bombs. The Hiroshima bomb was of uranium 235.

Production of materials for atomic bombs was at first planned to be located at Oak Ridge, Tenn. Later the plant for full scale manufacture of plutonium was built at Hanford, Washington, and the bomb laboratory was located at Los Alamos, New Mexico.

Thorium, as well as uranium, is a raw material for the atomic age, since a kind of uranium can be made from thorium, a much more abundant element than uranium. The importance of thorium in atomic energy production and control became known when proposals for international control were first made to the United Nations by the United States.

Thorium is bombarded with neutrons in a manner similar to the production of plutonium from non-fissionable uranium.

Nine atomic bombs are known to have been exploded, three in 1945, two in 1946 at Bikini, three in 1948 at Eniwetok, and one in 1949, if the U.S.S.R. explosion was a bomb.

Four elements heavier than plutonium have been created by alpha particle bombardment of lighter elements in cyclotrons at the University of California: 95, americium (AM); 96, curium (Cm); 97, berkelium (Bk); and 98, californium (Cf). Thus atomic energy research has added six elements to the 92 previously known.

THE HYDROGEN BOMB

A superbomb, the so-called hydrogen bomb, is being worked on in this country and presumably also in Russia. It is rated as having the possibility of being a thousand times as powerful as the plutonium or fission atomic bomb. This "fusion" bomb has not yet been made and exploded, so far as known. Work on the hydrogen bomb actually began during World War II. Without the fission bomb, the fusion superbomb would not be feasible since the extreme heat of the fission bomb would probably be used as the trigger to begin the more powerful explosion of the fusion bomb.

Tritium, which is the triple-weight isotope of hydrogen, probably would be the key material in the fusion bomb. It is made by bombardment of lithium metal with neutrons in an atomic reactor. Deuterium, double weight or heavy hydrogen, might also react fast enough to explode.

Machines for the acceleration of high voltage particles have played a major role in the discovery of atomic energy processes, plutonium having been made first in the cyclotron. Largest of the atom smashing apparatus so far built is the University of California's 184-inch synchro-cyclotron, using the

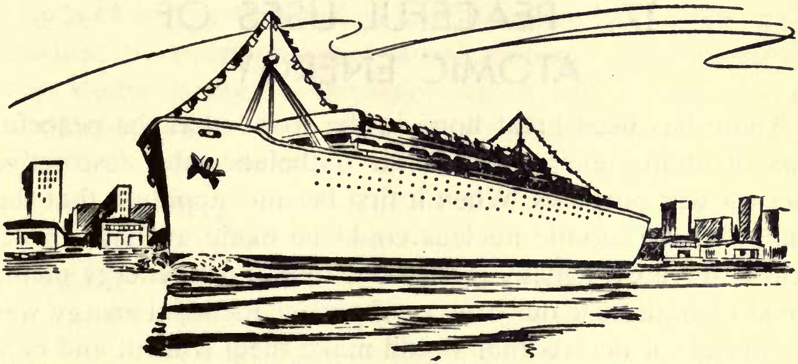
principle of frequency modulation to overcome relativity effects.

More than 50 particle accelerators are operating in the United States in the range of millions of electron volts. About an equal number are scheduled for construction. Synchro-cyclotrons are operating at Columbia University, University of Chicago and Carnegie Institute of Technology in the range of the University of California 184-inch cyclotron now in operation. A synchrotron is now in operation at Berkeley which for the first time accelerates electrons to energies of 300,000,000 electron volts.

Since even the largest present cyclotron possesses barely enough power to produce low-energy mesons, the Atomic Energy Commission authorized two gigantic accelerators which will be in the multibillion electron-volt range. Both are proton-synchrotrons. One of 60-foot diameter will be constructed at Brookhaven National Laboratory, Long Island, N. Y., costing approximately $3,000,000, producing three to five billion electron-volt protons. The other at Berkeley will be of 110-foot diameter, yielding five to seven billion electron-volt protons, and will cost approximately $9,000,000.

About 15 chain-reacting piles (nuclear reactors) are known to be operating in the world, about 10 of them in the United States. Canada and England, France and presumably Russia are the only locations of these atomic energy plants outside the United States. The large reactors at Hanford, Wash., produce plutonium for bombs from natural uranium with graphite as moderator. A smaller uranium-graphite reactor at Oak Ridge, Tenn., is used for research purposes and for production of radio-active isotopes. Argonne National Laboratory, near Chicago, has both a uranium-graphite and a uranium-heavy-

water reactor, both used for research. There are reactors at Los Alamos, New Mex., used in atomic bomb research, one of which is essentially an atomic bomb under control, releasing its energy slowly. It uses plutonium, produces fast neutrons and requires no moderator such as graphite or heavy-water. A research reactor at Brookhaven is in operation.



Nuclear energy is likely to have its first major power application in a naval ship—

Both radioactive and stable isotopes (elements alike except for weight) are available as by-products of the atomic energy program and are being used for research and in medicine, industry and agriculture. The 98 known elements have more than 800 isotopes. About a hundred radioisotopes are available from the Atomic Energy Commission at Oak Ridge, Tenn., and more than a hundred stable isotopes are obtainable from the A.E.C. or otherwise. One important radioisotope is carbon 14, with a half-life of 5,100 years, used as a tracer in investigations of photosynthesis, metabolism, chemical transformations of carbon compounds, etc. Radiocobalt 60, radioiodine 131 and radiophosphorus 32 are widely used in treatment of patients with cancerous diseases and in studying these

diseases. Many chemical compounds labeled with C 14 are available.

Attempts and proposals for the international control of atomic energy through the United Nations have reached a stalemate, with military developments secret in all countries.

17. PEACEFUL USES OF ATOMIC ENERGY

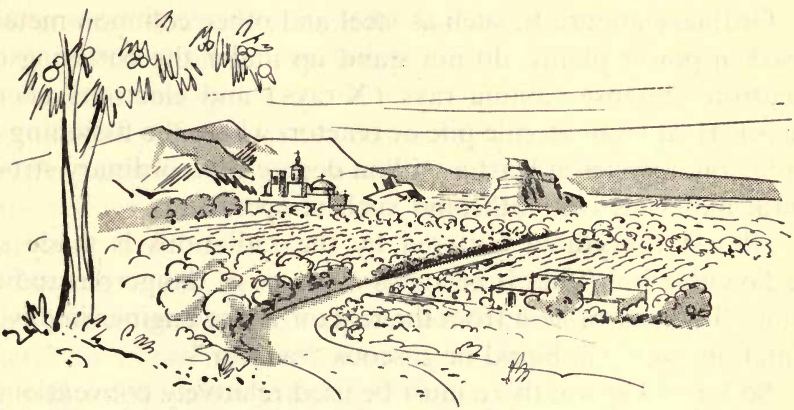
There has been great hope in the world that the peaceful uses of atomic energy would far outbalance the destructive uses for war purposes. When it first became apparent that the energy of the atomic nucleus could be made available practically, there were many predictions that atomic energy plants could revolutionize our sources of power. Plentiful energy was visualized for deserts that would make them fruitful and capable of supporting large populations. Areas of the globe that do not have supplies of oil and coal would be able to obtain uranium power to supply their energy needs.

The world's preoccupation with developing atomic energy for war has delayed the realization of these dreams of plentiful atomic power. A stumbling block in the application of atomic energy for peaceful power purposes has been the difficulty of control of atomic energy internationally. Atomic reactors in which uranium is fissioned with great release of energy could be converted very speedily into atomic bombs by any nation that would wish to divert the uranium and the plutonium in the great atomic "furnaces" to weapon purposes.

There should be atomic power plants running now, to fulfill the hopeful predictions of five years ago made just after the world knew that atomic bombs had been exploded.

As it is, after several seeming false starts, we are probably two to three years away from the successful operation of the kind of atomic power plant that might run submarines several times around the world without refueling.

Our atomic power bets are laid almost exclusively upon two ship propulsion reactors, one reported to be in the advanced stages of engineering design and the other just begun. As an auxiliary to weapons development, there are other projects of the Atomic Energy Commission which will aid the eventual power use of uranium at the same time that they help build more and better bombs.



There has been great hope that peaceful uses of atomic energy would far out-balance the destructive uses—

The military situation has dictated that virtually nothing be done in power development that does not contribute to our armed strength.

In the long run successful application of atomic power may not come any later due to this emphasis on fighting power. The problems in making a ship power plant are those of a stationary installation, with many conditions much more dif-

ficult. For one thing, the cost factor is thrown overboard, for a ship that does not have to refuel is priceless.

The cost of building an atomic ship reactor for the Navy is estimated as about $1,400 per kilowatt, which is about ten times as much as a conventional coal-burning power plant.

DIFFICULTIES OF USE

Intense radiation bombardment from the fissioning uranium or plutonium is the greatest difficulty in an atomic power plant. At least six feet of concrete is needed to shield the heat-producing reactor and make it safe for men and materials nearby.

Ordinary materials, such as steel and other common metals used in power plants, do not stand up under the battering of neutrons, intense gamma rays (X-rays) and electrons (beta rays). Heat in an atomic pile or reactor, where the fissioning is going on, reaches at least a million degrees. No ordinary structural materials can withstand such temperatures.

Almost everything battered by the radiations is made so radioactive itself that it becomes a source of dangerous radiations. Transfer of heat from the reactor to the engines involves handling so much liquid or gaseous "radium."

So far as known, there must be used relatively conventional methods of applying the heat of atomic energy to practical engines. Somehow the heat must be brought to the state of the few hundreds of degrees of temperature range that steam or turbo-jet engines can use.

Production of electricity directly from the neutron impact or the fission reaction itself is not unthinkable, but there has been no hint of any progress. Years ago there were attempts at direct electrical production from the flame of ordinary combustion, but without any marked degree of success.

The experience in atomic reactors or piles has been with slow neutrons, the energy range that seems easiest to use. Faster moving neutrons can be used and two of the AEC reactors are pioneering in this unknown field. A materials testing reactor is designed for the highest neutron flux yet attempted but it is merely a step toward other reactors. The second ship propulsion reactor will operate in the unexplored intermediate neutron range. This is important because this intermediate range will also allow the production of more fissionable material, breeding as it is called, than is fed into it.

An atomic energy plant or reactor is an atomic bomb kept under control. There is always the hazard of a run-away reactor that would explode as a bomb or otherwise, although the safeguards are many.

Any sale of power stocks or postponement of power development plans anywhere in the world, in anticipation of practical atomic power, is no more justified now than it was at the end of the war.

Using the world's precious fissionable material to boil water or the equivalent for gross power production may be a very wasteful use of our natural resources of uranium (and thorium from which fissionable uranium 233 can be made).

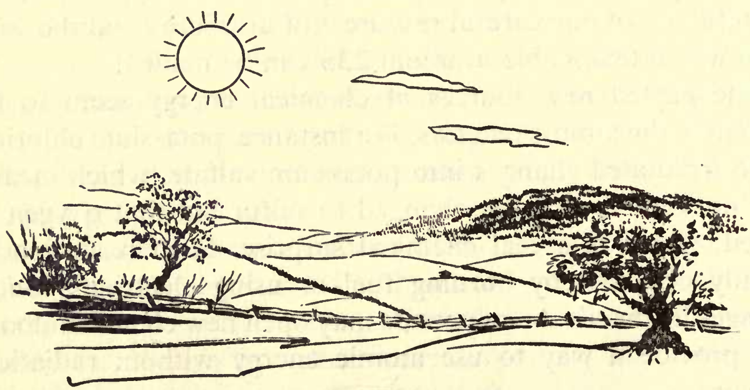
Unexpected new sources of chemical energy seem to be present in the atomic reactors. For instance, potassium chloride when irradiated changes into potassium sulfate, which means that not only is chlorine changed to sulfur but that oxygen is added, which is a real chemical surprise. Such oxidation is usually obtained by burning fuel or using electricity. Such changes in chemical compounds may open new chemical doors and provide a way to use atomic energy without radiation dangers.

USE OF RADIOACTIVE ISOTOPES

The many radioactive isotopes, also by-products of the atomic reactors, are considered by many to be as important as the atomic bomb itself, because of the discoveries that can be made with them. Other chemical reactions of the atomic furnace may be even more astonishing.

As examples, the use of just two of the radioisotopes may more than repay the world all the time and energy and money that has been spent on the development of the A-bomb and its by-products. Radiocobalt 60 is now widely used in the treatment of cancer, replacing the far more expensive radium upon which medical science had to rely a decade ago. More than the whole world's supply of radium can be matched by the radiocobalt that can be artificially created in an atomic reactor in a very short time. And this particular radioisotope is only one of a half-dozen which are used medically because of their radiations.

Radiocarbon 14 is being used extensively in research upon life processes in plants and animals, including the human body.



Photosynthesis is basic to all of our life here on earth—

One of the great research projects now under way is an investigation of a mechanism and method of photosynthesis, the process by which plants capture the sunshine and turn into materials containing available energy. This process of photosynthesis is basic to all of our life here on earth, because it makes it possible for the fields and forests to capture a small percentage of the sun's energy and store it up in food, wood and other substances. Even the oil and the coal and the peat of past ages owes its existence to the photosynthesis process. Now the factory can not do what the green leaf does in capturing the sun's energy. But researches in progress promise to produce a practical method of understanding photosynthesis and adapting it to "factory" use. When this is done, the peaceful results of this achievement will far outdistance the release of atomic energy by the fission process, and a new era of plentiful energy should begin if mankind can prevent the continuing destruction of war.

18. THE HYDROGEN BOMB—CAN IT BE MADE?

A thousand times or more powerful than the A-bomb is the H-bomb, the hydrogen or fusion bomb.

If it can be made, you can just go through this book multiplying by 1000, or 100, or 10 most of the effects discussed to make them apply to the H or superbomb.

The major question about the hydrogen bomb is: Can it be made and will it explode as expected?

You may be confident that the hydrogen bomb is in about the same state that the uranium bomb was about 1943 or 1944, a year or two before the first atomic explosion. Scientists

think it can be done and the Atomic Energy Commission is working on it. Undoubtedly the U.S.S.R. is working on it, too, and may even get there first.

The hydrogen bomb has not been made or exploded. That is a matter for the future.

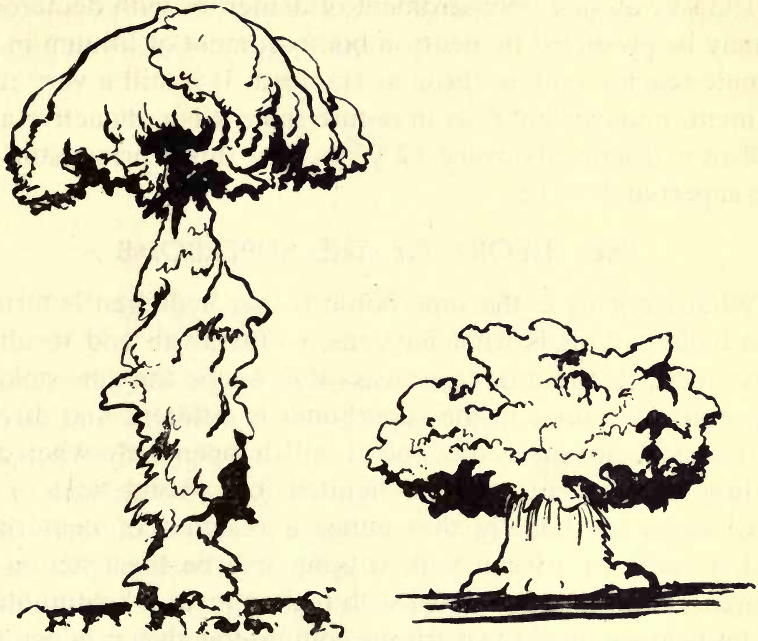
The hydrogen or superbomb reaction is different from that of the atomic or A-bomb made of fissionable materials, uranium or plutonium. The energy comes from the changing of matter into energy, as Einstein computed, but the lightest elements known are involved in the "fusion" process of the superbomb.

The size of the fission or A-bomb is limited by the circumstance that if too much of the fissionable metals—uranium 235 or 233 or plutonium—are brought together they will explode because the neutrons from their exploding atoms will start and maintain a chain reaction. This critical mass is somewhere between 2.2 and 220 pounds, exactly what is secret. The A-bomb is set off by bringing together suddenly two pieces of less than critical mass which together will be more than the amount that would start the explosion.

Instead of being self-starting, the superbomb needs the high-temperature "trigger" of a fission bomb to get it going. It is safe to bring large amounts of the raw material of the superbomb together—it can weigh a ton or more. Its size is limited only by the amount of hydrogen "fuel" that can be "set fire" in the few billionths of a second of the explosion of the "igniting" A-bomb. The high temperature necessary to set off the superbomb can be provided by the tens of billions of degrees Centigrade of the A-bomb explosion.

The speed with which the hydrogen atoms can react under such heat determines what will make the superbomb.

Certainly the ordinary kind of single-weight hydrogen will not do, for it takes far, far too long. Computations show that such reactions, which keep the sun stoked with energy, extend over billions of years. Billionths of a second are more like what is necessary in the fusion superbomb.



The H-bomb is 1000 times more powerful than the A-bomb—

KINDS OF HYDROGEN

It is just as well that there are three kinds of hydrogen. The commonest is the ordinary sort in the waters of the earth. Its heart or nucleus consists of one proton. Then there is heavy hydrogen, or deuterium, which was discovered here in America in 1931, which is naturally present as 1/4500th of hydrogen in

nature. This is hydrogen 2, with a nucleus of one proton and one neutron, which as a particle is called a deuteron. Then there is tritium, the third kind of hydrogen, "heavy, heavy hydrogen," which has a nucleus of one proton and two neutrons, called a triton. A team of British physicists first made it in 1934 by atomic bombardment of deuterons with deuterons. It may be produced by neutron bombardment of lithium in an atomic reactor such as those at Hanford. It is still a very rare element, non-existent now in nature since it is radioactive and half of it disappears every 12 years. Yet this a prime stuff of the superbomb to be.

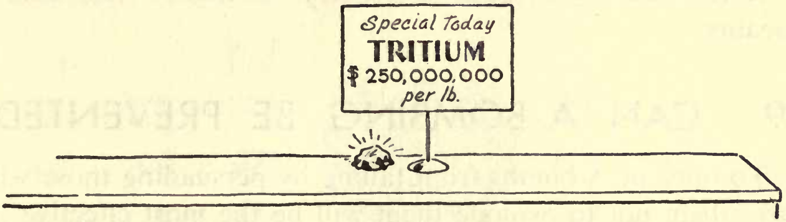
THE THEORY OF THE SUPERBOMB

What happens in the superbomb is that hydrogen is turned into helium. This is what happens, so far as an end result is concerned, in the atomic process that keeps the sun stoked. The transformation in the superbomb is different and direct. It is almost instantaneous and it will happen only when the hydrogen is concentrated and "ignited" by A-bomb heat.

It seems most likely that either a reaction of deuterium with tritium, or tritium with tritium, will be the reaction of choice. Deuterium combined with tritium gives a helium atom and a neutron, while two tritons coming together produce the helium atom (alpha particle) and two neutrons.

The heavier hydrogens are expensive, although the AEC price tags upon them now are not fair values of their cost in the superbomb production. (For research purposes it is possible to buy from the A.E.C. five cubic centimeters of 50% tritium gas at a cost of $1,315 which figures out to something like the fantastic figure of a quarter of a billion dollars per pound.) Deuterium can be concentrated out of ordinary water, but tri-

tium must be made with the use of fissionable material, competing for neutrons with the production of plutonium which is the principal job of the big atomic reactors at Hanford, Wash. Tritium is made by neutron bombardment of the very light metal lithium, much the same way that plutonium is made by bombardment of uranium 238 by neutrons from the controlled fissioning of uranium or plutonium.



Tritium is sold by the A.E.C. for research purposes—

The heavier kinds of hydrogen would be put into the superbomb in as concentrated form as possible, which means that they must be under very great pressure or very cold or both. Or they may be used as solid compounds—this is speculation but the uranium of the trigger bomb might be combined with the heavy hydrogens to form a solid.

The problems in making the superbomb seem very much more complex than the making of the original uranium bomb must have been. Of course, we know now that the fission (uranium or plutonium) bomb will go off. We are not so sure that the superbomb will explode the way that we expect it. What has been done is so much simpler than what has never been done.

Except for the fear that others will do it first and use it against us, it would be foolish to try to make the hydrogen bomb. Even the making and stockpiling of tritium is a bad

business as we shall lose half of our supply every 12 years, due to its radioactive disintegration.

Some scientists argue very strongly that we should not try to make the superbomb. Certainly it has no industrial or peacetime uses that can be foreseen now. Its reaction is just too big, sudden and powerful. There seems to be no way you can use the reaction in a power plant.

If it works, it is devastation beyond man's most hellish dreams.

19. CAN A-BOMBING BE PREVENTED?

To prevent A-bombs from falling by persuading those who have them not to explode them will be the most effective A-bomb protection. Several factors in the world situation may prevent A-bombs from being exploded.

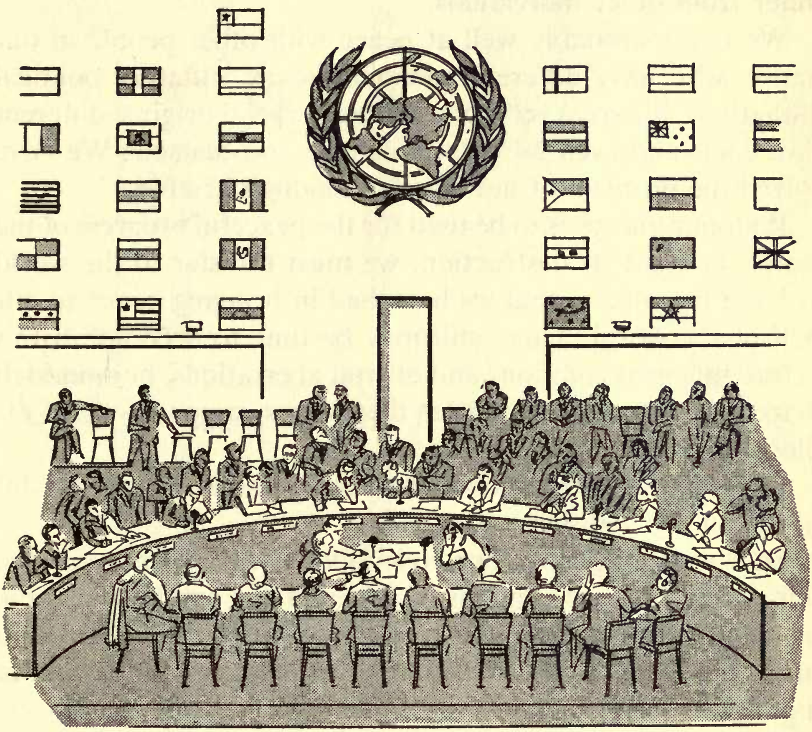
First of all, if there were no conflict between nations there would be no wars and no possibility of A-bombings. Even if there is war on a large or a small scale, both the Soviets and the United States may refrain from using A-bombs. The United States, as a national policy, will use A-bombs only as a retaliation in the future. It will not start an atomic war.

The Soviets, if they have the A-bomb perfected and ready for military use, probably do not have as large stocks as the United States and the threat of retaliation by the United States may deter Russian A-bomb attacks.

The best protection of our civilian population would be the avoidance of war. Whether we have war depends not alone upon ourselves and our leaders, diplomatic and military. The decision to make war upon us lies largely in the hands of our enemies.

We can do something to persuade our rivals in a divided world that they can exist safely without waging war. That is the prime purpose of the cold war, our international negotiations, our fight for peace within the United Nations, our Voice of America, psychological push for peace.

Part of the difficulty of any conflict, whether it is between individuals, groups of peoples or nations lies in the conceptions and misconceptions of the people involved. We do not like



To prevent A-bombs from falling by persuading those who have them not to explode them will be the most effective A-bomb protection—

other people because we do not know them, and we do not understand them. They think differently from the way we do—at least they have had different childhood experiences, different schooling, different training, different living conditions, different food, different language, different clothes from us.

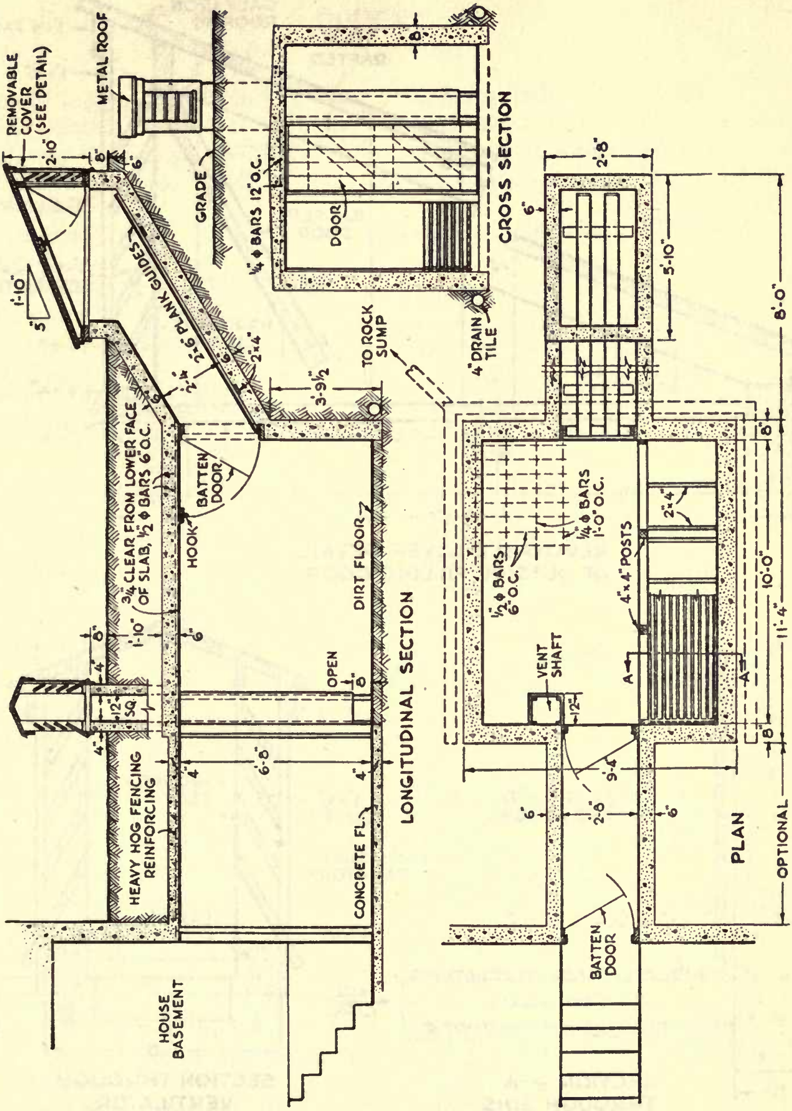
Superficially, at least, they are quite different. Fundamentally, the scientists tell us various peoples do not differ from other peoples much more than individuals in our own community differ from other individuals.

We live reasonably well at peace with other people in our nation who have different economic ideas, different political affiliations, different religions, different racial origins, different skin color and even different language and dialects. We have solved the problem of not warring among ourselves.

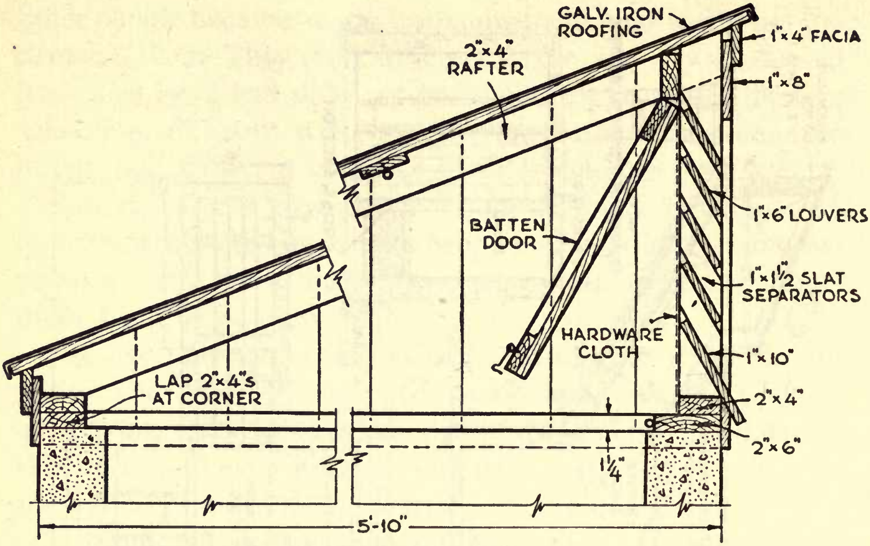
If atomic energy is to be used for the peaceful progress of the world, and not its destruction, we must transfer to the world at large the success that we have had in bringing peace to our half of the world. There still may be time to accomplish this before inflamed emotions and mental aberrations, both in high places and among the peoples themselves, trigger a world explosion.

Everyone can understand both the possibility and the difficulty of not fighting.

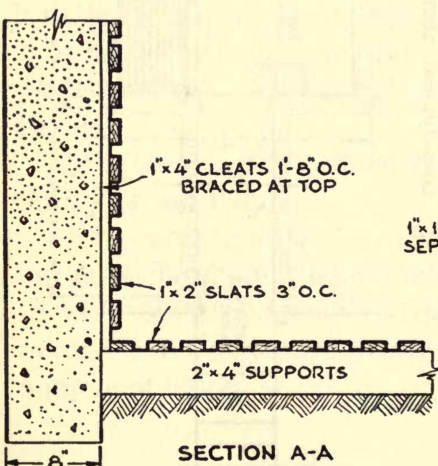
Our good neighbors, our civic labor and industrial leaders, our politicians, our religious leaders and our psychiatrists help us keep ourselves and our community at peace. The world needs the same effective treatment if it is to cure itself without a purge of blood.



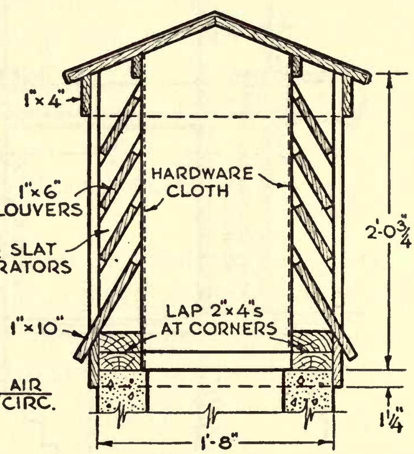
Plan and Sections for a Simple Shelter.



REMOVABLE COVER DETAIL
OF OUTSIDE FILLING DOOR



SECTION A-A
THROUGH BINS



SECTION THROUGH
VENTILATOR

Details of a Simple Shelter.

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